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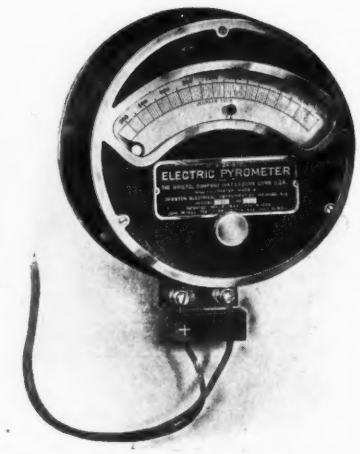

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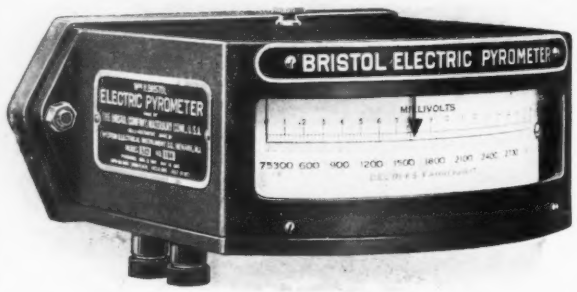

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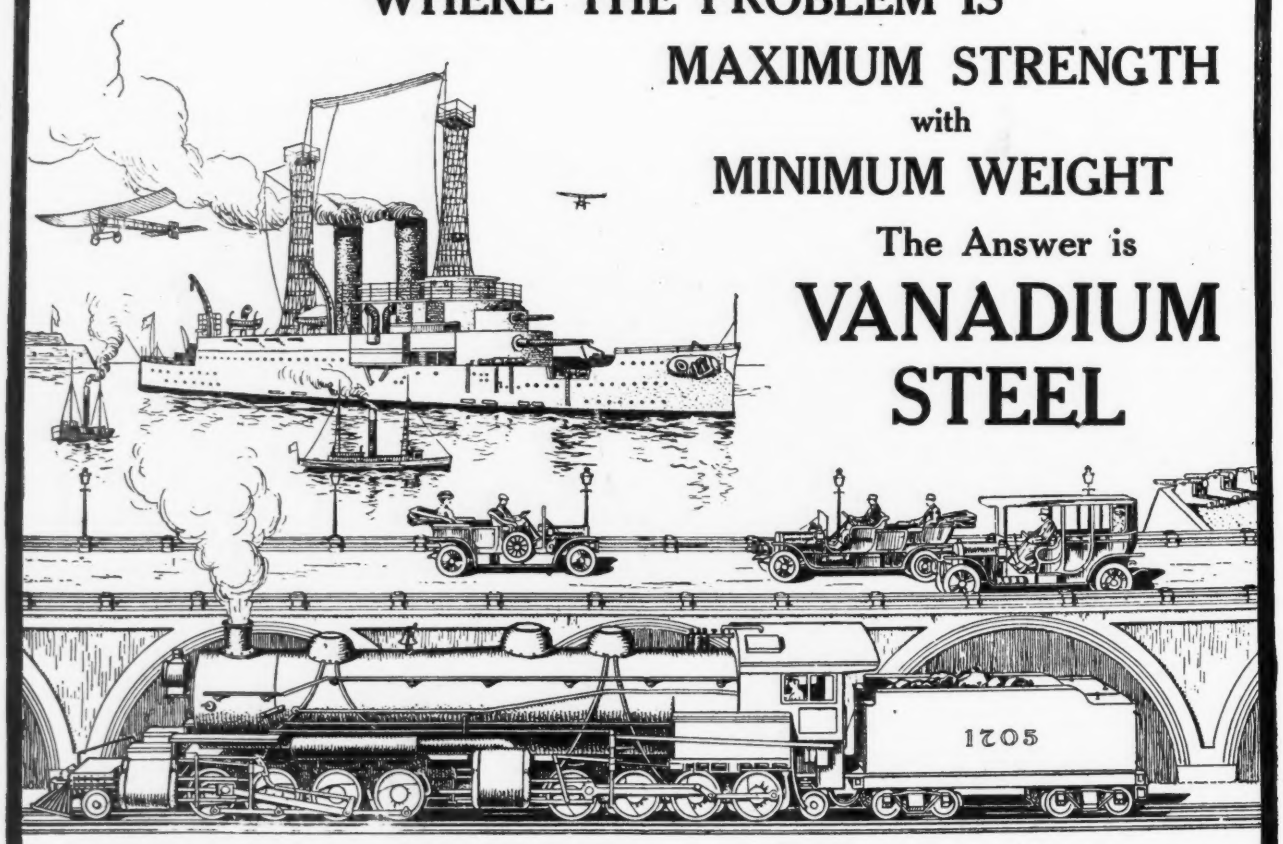
MAXIMUM STRENGTH

with

MINIMUM WEIGHT

The Answer is

VANADIUM STEEL



AMERICAN VANADIUM COMPANY PITTSBURGH NEW YORK LONDON

Manufacture of Ball Bearings

BALL bearings are now being used extensively in motor cars, machine tools, and other machinery to reduce friction and increase the life of moving parts. For example, manufacturers have employed ball bearings on lathe spindles with remarkable results; high-speed drilling machines constructed with ball bearing spindles have given complete satisfaction. Satisfactory use of ball bearings has been made in internal grinding wheel spindles where speeds as high as 30,000 R. P. M. have been obtained without any perceptible chatter or heating of the bearings. The advantage gained by rotating a grinding wheel spindle at speeds as high as 30,000 R. P. M. is that small wheels can be operated at their highest cutting efficiency. Objections have been raised in the past to the use of ball bearings in machine tools, but many of these have been unfounded; the present ball bearing is so accurately made that there is little trouble from noise or vibration even at high speeds. But this condition was realized only after the heat-treatment of steel had been fully developed and ball and race making had been perfected.

Excluding special sizes and shapes, ball bearings are made in three distinct types, *viz.*, radial or annular, thrust, and a combination of both. The radial bearing is the type most extensively used, and consists of inner and outer races with grooves in their opposing faces, between which a row of balls is retained in a cage. Some radial bearings are made with one row of balls, whereas others have two rows and are adapted for carrying heavier loads than the single-row type. The following description is confined to the manufacture of single-row ball bearings as followed by the U. S. Ball Bearing Mfg. Co. of Chicago, Ill.

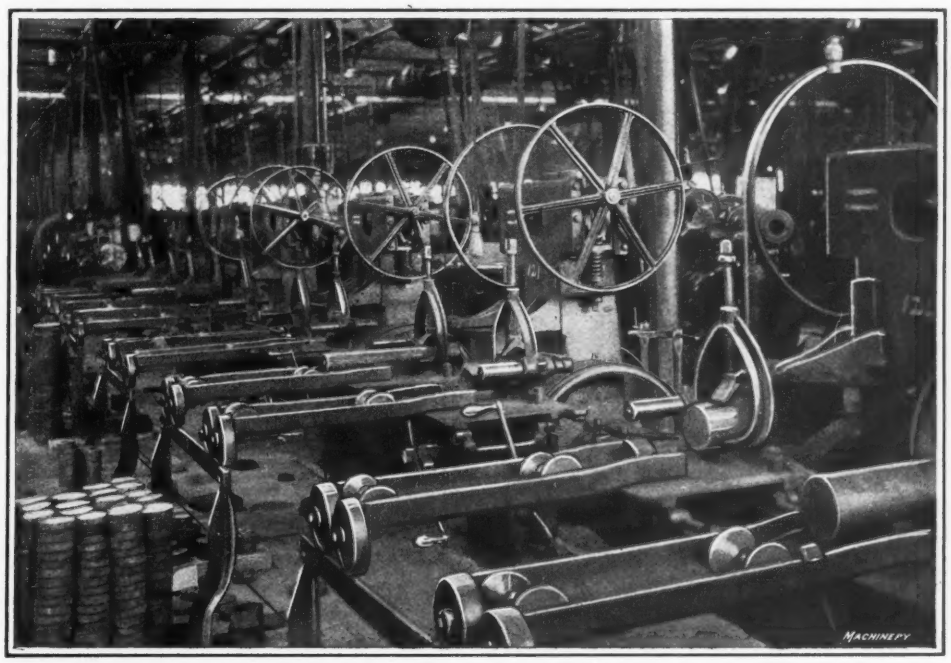


Fig. 1. Group of Duplex Band Sawing Machines used in the U. S. Ball Bearing Mfg. Co.'s Plant for cutting off Bar Stock for Ball Bearing Rings when only a Small Number of One Size is required

Preliminary Operations

The U. S. Ball Bearing Mfg. Co. employs several

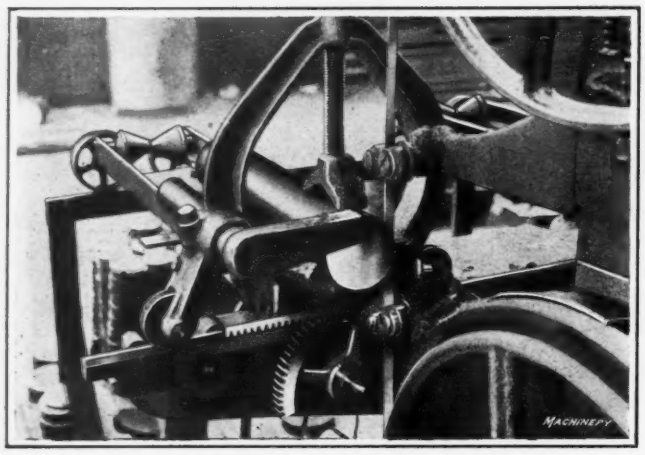


Fig. 2. Close View of Duplex Band Sawing Machine, showing how Saw is guided and supported; also Method of operating Feed Slide

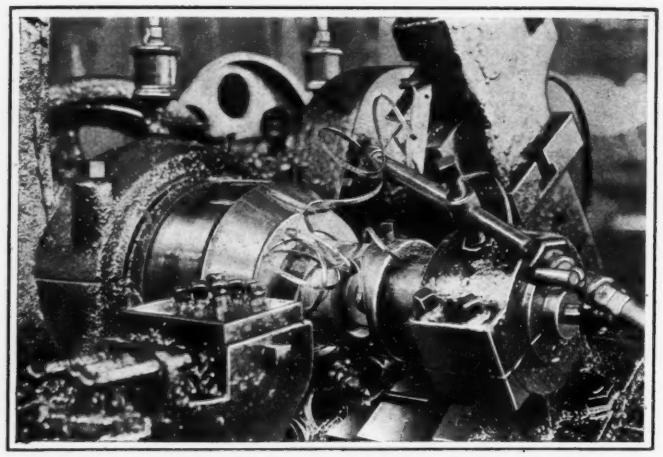


Fig. 3. Making Two Ball Bearing Rings at One Time in a Gridley Single-spindle Automatic Screw Machine by Means of a Trepanning Tool

different methods for performing the preliminary operations on radial ball bearings. The method used depends upon two conditions, *viz.*, the size of the bearing and the number required. For the smaller sized bearings up to 6 inches diameter where large quantities are required, the preliminary operations are as follows: bore, turn, face and trepan rings from bar stock in a Cleveland or Gridley single or multiple automatic. These rings are then disk-ground, after which they are taken to the lathe or screw machine to have the corners rounded. From this point on all bearings pass through the same processes. When only small quantities of a size less than 6 inches diameter are required, the blanks are cut off on band saws and finished in the hand turret lathe and engine lathe. For bearings over 6 inches diameter, hand forgings are used. The preliminary operations consist in boring, turning and facing in the turret lathe; the succeeding operations are the same as those used for the smaller sizes.

Assuming that a small lot of bearings, 2½ inches diameter, is required, the first operation would be cutting off a disk of the desired size in the duplex band saws shown in Figs. 1

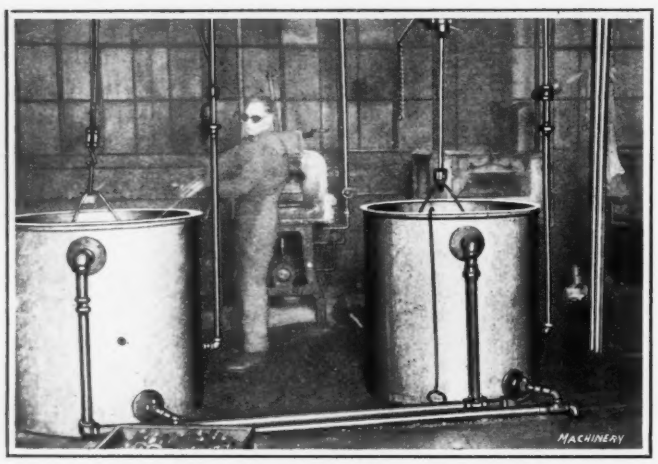


Fig. 4. Hardening Ball Bearing Ring

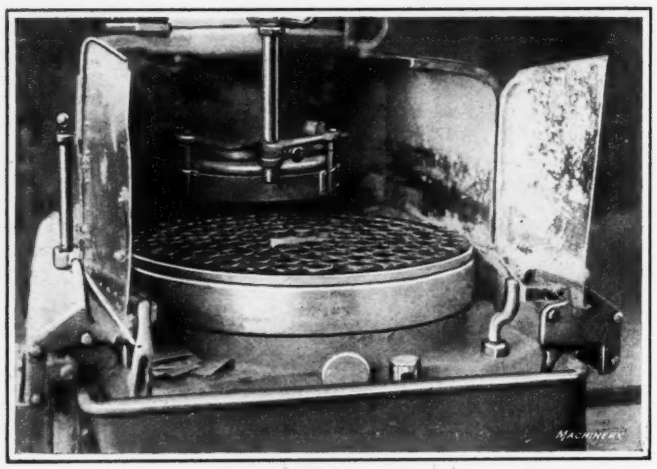


Fig. 5. Grinding Sides of Rings on Blanchard Vertical Surface Grinder

Fig. 6. Leeds & Northrup Electric Pyrometer used for regulating and determining Temperature in Hardening Furnaces

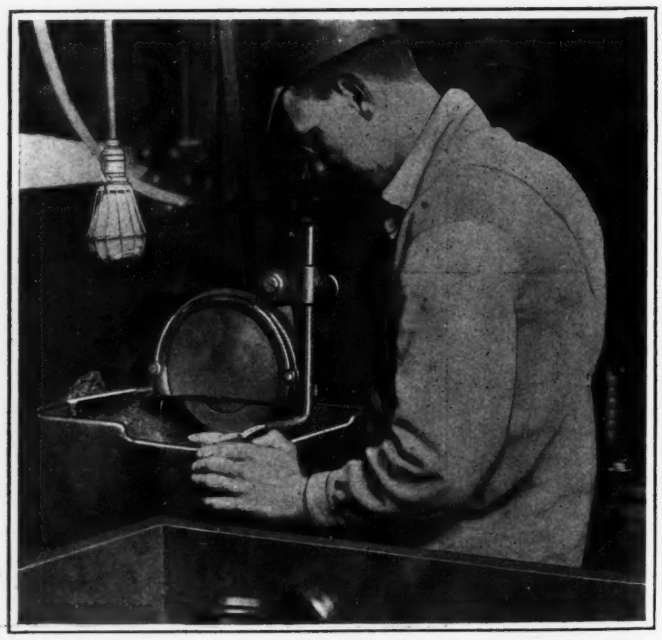


Fig. 7. Grinding Sides of Ball Bearing Rings on Heald Piston Ring Grinder—This Machine is used where Extreme Accuracy is required

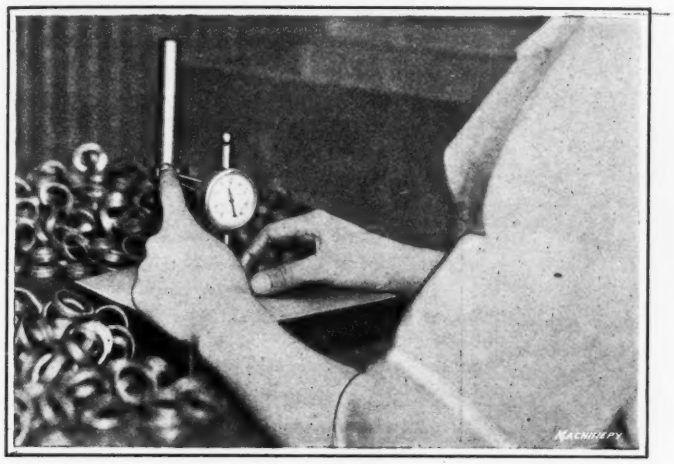


Fig. 8. Testing Ball Bearing Race Rings for Thickness—Limit is Standard — 0.001 Inch

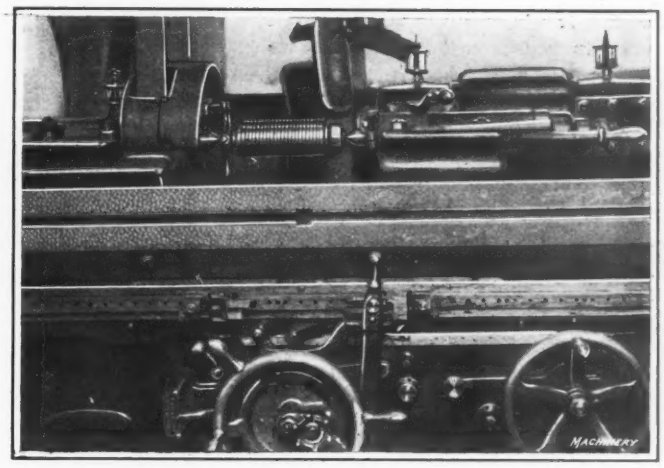


Fig. 9. Grinding External Diameter of Outer Race Ring on Plain Cylindrical Grinding Machine

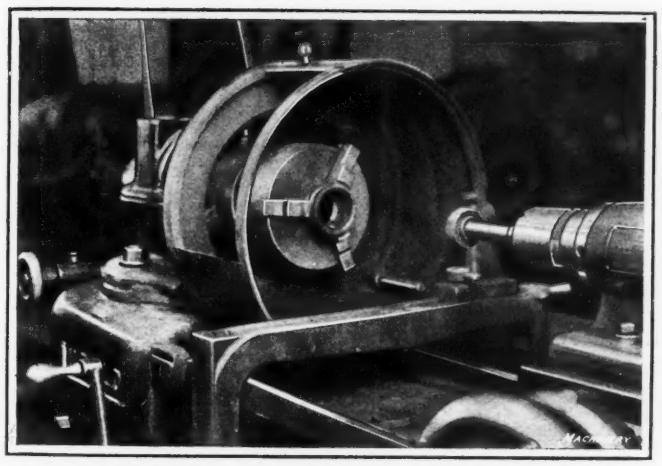


Fig. 10. Grinding Internal Diameter or Hole of Inner Race on Heald Internal Grinding Machine

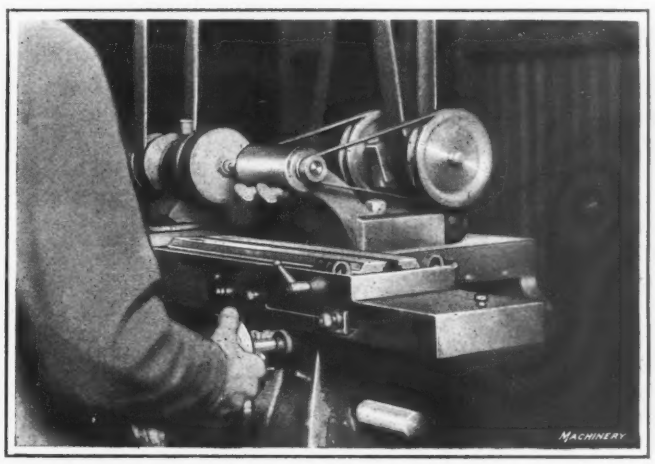


Fig. 11. Grinding Internal Diameter or Hole of Small Ball Bearing Rings in Rivett Internal Grinding Machine

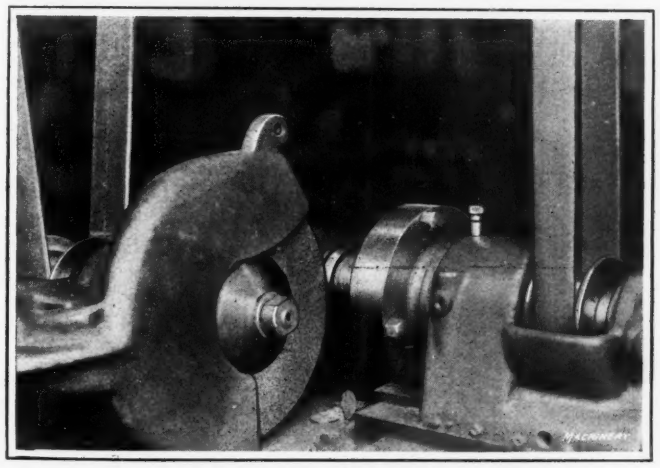


Fig. 12. Grinding Ball Race in Inner Ring on Van Norman Ball Race Grinding Machine

Fig. 13. First Operation on Ball Bearing Retainer—This is made from Sheet Steel and is finished in Four Operations

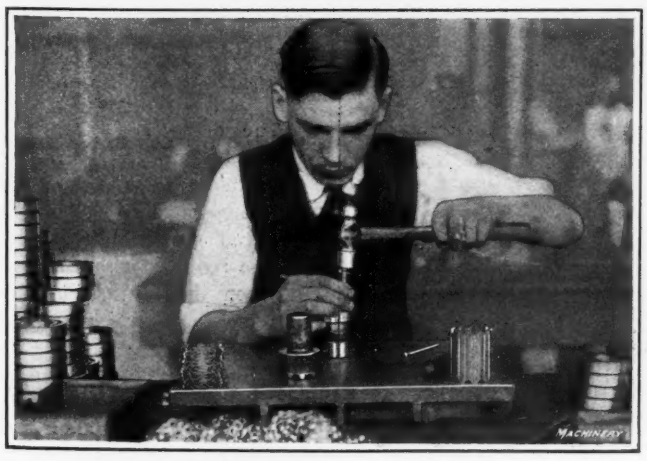


Fig. 14. Assembling Ball Bearings—upsetting Ends of Rivets

Fig. 15. Testing Ball Bearings for Noise

and 2. The bar is clamped in a vise as shown in Fig. 2, and located endwise by a stop set to give a blank of the required thickness. The band saw used is 1/32 inch thick, ½ inch wide, and approximately 12 feet, 9 inches long. It is guided by four hardened and ground rollers. The carriage carrying the vise in which the bar is held is advanced toward the saw by a weight acting through a rack and segment gear. The hardened rollers that guide the saw blade keep it taut and at the same time enable the machine to cut a bar off straight with the least waste of stock. The amount left for finishing on the sides is about 1/32 inch. Following the cutting off of the blank, it is bored, reamed, faced, turned, trepanned, etc., and is then ready for hardening.

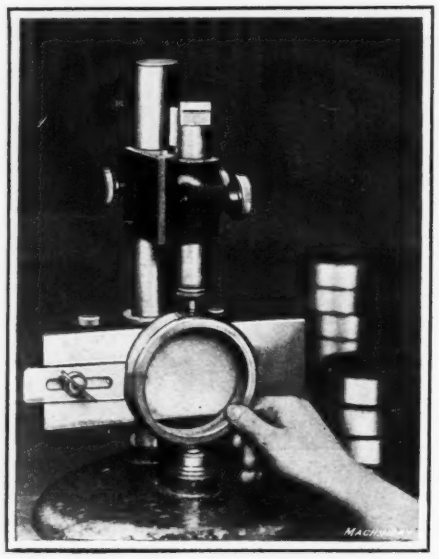


Fig. 16. Inspecting External Diameter with a Hirth Minimeter—Limits allowed are Standard — 0.0002 to 0.0004 Inch on Diameter

Machining Ball Bearing Rings on Gridley Automatic

Ball bearing rings up to 4¼ inches in diameter are finished on Gridley single-spindle automatics, and, as a rule, two rings are made from one bar. This is accomplished as shown in Fig. 3 by using a trepanning tool which cuts an annular groove in the end of the bar, producing two rings when cut off. This is much more economical than making one ring from a bar, and as high-grade alloy steel tubing suitable for this work cannot be obtained at the present time, this has been found to be the most economical method. On a Gridley single-spindle automatic, the feeds per revolution of the work used are: drilling, 0.015 inch; trepanning, 0.010 inch; and forming, 0.0015 inch. The surface feed for forming is about 60 feet per minute. On a 2¼-inch Gridley automatic, 200 completed bearings—two rings—are turned out in ten hours, and 97 of the same size are turned out on the single-spindle automatic in the same time.

Disk-grinding Sides of Bearings

After the bearing rings have been cut off in the automatic, they are brought to a Gardner disk grinder, where about 0.005 inch is ground from both sides, leaving about 0.004 inch on each side for finishing on the Blanchard vertical surface grinder. The sides are ground by passing the rings between two face grinding wheels. The bearing rings are then taken to a turret lathe, where the ball races are turned in the inner and outer rings and the corners broken on both the inside and outside. The bearing rings are then taken to a punch press, where they are stamped and inspected to see that the previous operations have been properly carried out.

Hardening and Tempering

After the ball bearing rings have passed inspection, they are taken to the hardening department, where they are heated in a gas furnace to from 1450 to 1500 degrees F., as shown in Fig. 4. It requires from fifteen to twenty minutes to bring up a batch of these ball bearing rings to the required temperature, depending on their size, and the temperature is regulated and controlled by means of a Leeds-Northrup recording and indicating pyrometer, as shown in Fig. 6. When the rings in the furnace have been heated above the critical point, they are removed and immersed in a special quenching oil kept at a constant temperature of 55 degrees F. by circulating water through coils cooled by a refrigerating plant. The ball bearing rings are then drawn or tempered in the same oil as that used for hardening, which is kept at a temperature of 350 degrees F. For tempering, the rings are put into the oil when it is cool, and the temperature is gradually raised to the desired point, which requires about twenty-five minutes.

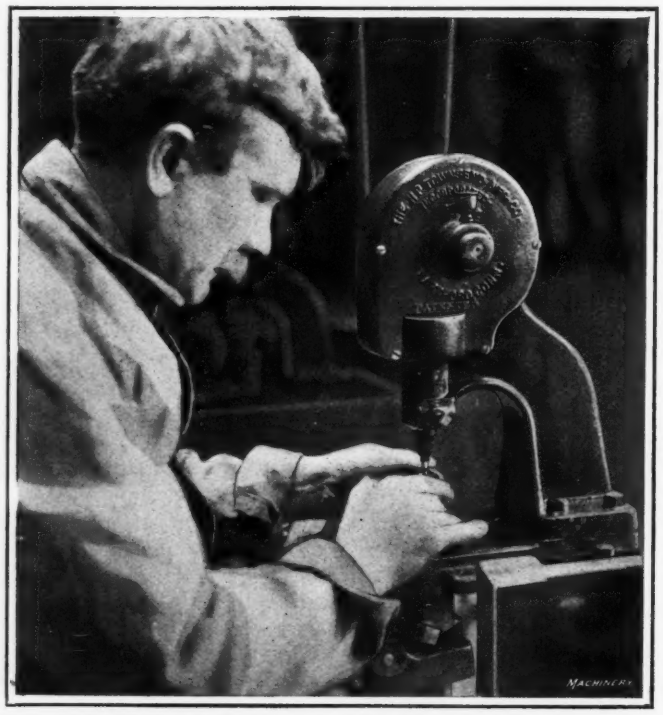


Fig. 17. Heading Rivets in a Townsend Riveting Machine—Rivets hold Halves of Ball Bearing Retainer together

Testing

All ball bearing rings, after hardening and tempering, are tested by what is known as a bounding test. The smaller rings are thrown onto an iron block, and the larger rings are rolled down an incline and bounced up against a cast-iron block. The tester can tell by the ringing sound whether it is too soft, is cracked or has any other defect. If this is so the sound is deadened. If the race, on the other hand, is too hard it will break. This test may appear to be rather drastic, but after long experiments with other testing apparatus, it has been found that the most accurate results can be obtained in this way, provided the man making the test knows his business. Of course, other tests are also taken with the scleroscope to check up the bounding test, and in addition, all rings are given a file test in the races.

Surface Grinding

After the rings have been tested by bounding and with a scleroscope, they are taken to the Blanchard surface grinder, shown in Fig. 5, where both sides are ground to the required thickness. On a 2½-inch race 120 pieces are held on the magnetic chuck at one time, and the production is 500 in two hours. The down feed of the wheel is 0.001 inch, and the speed of the table, 17 R.P.M. When extreme accuracy is required, the Heald piston ring grinder shown in Fig. 7 is used.

After grinding the rings on the sides, they are demagnetized by a simple apparatus consisting of two coils fastened to the under side of a work bench which has a hole cut through the planks. The races are slowly passed down through the hole and subjected to an alternating current, with the result that practically all of the residual magnetism is removed. The rings are now inspected for thickness. This is done with a dial test indicating gage, as shown in Fig 8; the variation in thickness on these rings is standard — 0.001 inch. The multiplying lever arrangement is not used in this case.

Grinding and Inspecting Outer Ring

The outer rings are now brought from the inspection department to the cylindrical grinding machine where the external diameter is ground to the required size. As will be seen in Fig. 9, ten rings are held on a mandrel at one time and the external surface is ground to the required size. The rings are a free fit for the mandrel and are clamped from the end by a washer or nut. The limits

on the external diameter are standard —0.0002 to 0.0004 inch, depending upon the size of the ring. After grinding the external diameter, the outer race is tested for accuracy by a Hirth minimeter, as shown in Fig. 16. The ball measuring point of this Hirth indicator is set by means of a Johansson block, and the inspector gages the external diameter by rotating the ring on the lower ball anvil, holding the race meanwhile against the centering block and at the same time watching the movement of the indicating needle, which has a measuring ratio of 10 to 1. This particular gage is inspected every day, and when the balls become flat they are rotated to bring a spherical surface in contact with the work.

Continuing the operations on the outer ring, the next step is to grind the race for the balls. This operation is accomplished in Van Norman or special race grinding machines. The method of grinding ball races on the Van Norman race grinding machine was described in the August, 1915, number of MACHINERY.

Grinding Operations on Inner Ring

The first grinding operation on the inner ring, after it leaves the Blanchard surface grinder, is accomplished in a Heald or Rivett internal grinder, depending on the size of the race. Fig. 10 shows a Heald internal grinding machine set up for grinding an inner ring for a 2½-inch bearing. The limits on the hole are standard —0.0002 to 0.0004 inch, depending on the diameter. The gaging of this diameter is accomplished by means of the standard "go" and "not go" plug gages. Fig. 11 shows a Rivett internal grinding machine set up on a smaller race.

The race groove in the inner ring is ground on Van Norman race grinders, and a battery of special machines built for this work by the company. During this operation the ring is held in a special chuck, as shown in Fig. 12. After finish-grinding, the races are ready for inspection prior to assembling.

Making Ball Retainer

The ball retainers are made from sheet steel in several operations in the punch press, and are then assembled under a riveter. The first operation is to blank out a ring in an inclinable punch press, as shown in Fig. 13, using a combination blanking and piercing punch and die. Second, this ring is rough-formed with a punch and die having a series of circular projections; then it is taken to another punch and die where the final operations are accomplished, and at the same time the holes are pierced for the rivets. Following this, the retainers are taken to the assembling department, together with the rings, for final inspection and assembling.

Assembling Balls, Retainers and Rings

For assembling, the rings are placed eccentrically and the required number of balls inserted. The two sides of the retainer are then assembled and the rivets inserted by a girl. The loosely assembled bearing is now passed on to another assembler, as shown in Fig. 14, who sets the rivets to prevent them from falling out, and then the bearing is taken to the riveting machine shown in Fig. 17. The rivets are of the headed type, so it is only necessary to rivet one end.

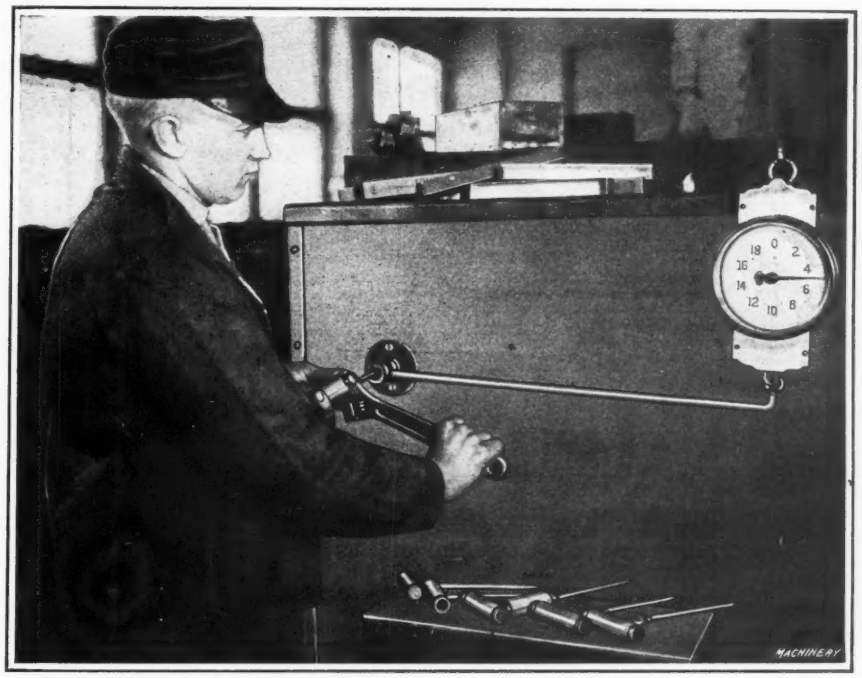
The bearings are now carefully looked over for imperfections and are then given the noise test, as shown in Fig. 15. Here the two bearings are located on a shaft and are held in grooves in a special bench fixture. This shaft is provided with a grooved pulley over which a belt runs, connected to a ½-horsepower motor. The speed of these bearings is then increased to about 1200 R. P. M., and if any noise is detected it is a sure sign that the balls are out of round, have soft spots or other imperfections. After testing for noise, they are carefully coated over with a vaseline compound, packed in tissue paper and stocked.

D. T. H.

* * *

APPARATUS FOR TESTING CRESCENT SCREWDRIVERS

On page 144 in the October, 1915, number of MACHINERY was described a hydraulic testing apparatus used by the Crescent Tool Co. of Jamestown, N. Y., for testing the strength of wrenches. In the following is described another device used by the Crescent Tool Co. for testing the strength of screwdrivers and detecting soft blades or other hardening defects. The particular tools shown being tested in the accompanying illustration are Crescent hammer-handle screwdrivers, but all Crescent screwdrivers are tested on this apparatus after being hardened.



How Crescent Screwdrivers are tested

The apparatus is so extremely simple that it needs little description. Upon the side of the testing wall a central stud is located on which a long lever is pivoted. The fulcrum point of this lever is slotted to receive the screwdriver blade. The lever is approximately twenty-four inches long and is attached at its outer end to the weight hook of a spring balance—the weighing pan having been removed.

The inspector inserts the blade of the screwdriver in the slot at the center of the pivoted arm, and with a wrench turns the arm and pulls down the scale beam or slide until the indicator reaches a predetermined number of pounds, according to the size of the screwdriver blade being tested. If the scale indicator reaches its mark without causing the blade to bend or break, the screwdriver is adjudged perfect and put through the finishing department. If, on the other hand, it fails in the test, it is rejected. The operation is extremely simple and rapid.

C. L. L.

* * *

Careful cleaning of castings for machinery that is highly finished like machine tools pays, as less filler is required to cover the scabby places. The less filler used the better the results, as heavy filler is likely to crack and peel off in use. In order to produce the most satisfactory condition, portable grinders should be used freely to grind off all roughness. This preliminary work costs considerable, but it is more than made up in saving of time and filler when preparing for painting. The job is more durable, too; the less paint and filler used to cover a surface evenly, the better the job.

TESTING NON-FERROUS METALS FOR HARDNESS

APPLICATIONS OF THE BRINELL METHOD IN REGULATING METHODS OF MANUFACTURE

BY HUGO FRIEDMANN*

A NUMBER of satisfactory types of apparatus for testing the hardness of metals are now available, but we still have much to learn about interpreting the results of hardness tests. The results so far attained are just sufficient to excite interest and to cause new efforts to be made in this direction. One of the chief obstacles to a satisfactory interpretation of the results of hardness tests has been that there are no uniform hardness standards for different classes of metal. Satisfactory methods have been developed for testing other properties which are inherent in different metals and the results of such tests are expressed in well defined terms, but the relation between the hardness numbers of metals and other physical properties varies in so many ways that no general law has been established to connect these properties. Despite these limitations the results of hardness tests have already been found of great practical value, particularly in the case of groups of metals of similar chemical compositions. In such cases the results of hardness tests show certain standard relations to each other and to other physical properties of the metals. The chief advantages of the method of conducting hardness tests, as compared with other methods of testing, are the rapidity with which the work can be done and the fact that the making of a hardness test does not destroy the test piece.

Extensive researches have been made with the view of determining the relation of the hardness values of iron and steel of various chemical compositions to other properties of the metal. But less attention has been paid to the determination of similar data for the non-ferrous metals, and information relating to the practical value of the hardness test on non-ferrous metals is quite meager. The purpose of the present article is to present a number of facts concerning the results of hardness tests on aluminum, copper, brass, bronze and certain other non-ferrous alloys. Part of this information is only negative, but it should nevertheless be of value in pointing out the possible uses and applications of the hardness test in factory work.

Method of Making Hardness Tests

Most of the data presented in this article have been obtained through the use of the Brinell ball tester, and we will assume that this apparatus and the principle upon which it operates are generally understood, so that only a brief description will be presented, outlining distinctive features of the apparatus as applied to the testing of non-ferrous metals. It was recommended by the International Congress for Testing Materials that only loads of 500 kilograms and 3000 kilograms should be used in making tests with the Brinell machine, owing to the fact that hardness tests determined with other loads are not strictly comparable. As the 500-kilogram load was recommended for testing the softer classes of material, it would appear that this should be the proper load to employ in making tests of non-ferrous metals, but in practice it has not been found advisable to make tests in this way. Although brass is usually too soft to be tested with a load of 3000 kilograms, the 500-kilogram load makes very small impressions, the limited dimensions of which reduce the accuracy of the measurements and the range of differences in hardness which can be determined. In making tests on non-ferrous metals, experience has shown that it is advisable to employ a load of 1000 kilograms, bearing in mind the fact that the results of such tests cannot be compared with the results of tests made with some other load. In testing sheet metal of less than ⅛ inch thickness, some other standard must be adopted, as the application of a load of even 500 kilograms is found to be too severe. In conducting the tests, the use of a sand-glass which runs for one-half minute will be found convenient in maintaining a uniform time limit.

* Deceased, February 20, 1916.

Method of Testing Castings

It is a difficult matter to secure accurate results from hardness tests of castings. Ordinary castings of brass, aluminum or bronze which have not been subjected to some mechanical treatment, do not show clearly defined circular impressions when it is attempted to determine their hardness by the Brinell method. The circumference of the impression is irregular, making it a difficult matter to measure the diameter accurately; and to secure reasonably accurate results, it is necessary to take three or four measurements of each impression and use the average value. The irregularity in the form of the impression is largely dependent upon the method of making the casting, and although it might reasonably be assumed that the indentations around the circumference of the impression would be governed by the crystalline structure of the metal, experience has shown that this is not the case. In order to secure definite information on this point, the writer made a series of combined microscopic and Brinell hardness tests. The test samples were first etched on a highly polished surface, after which the ball was pressed in. In a series of such tests the microscope failed to reveal any relation between the irregularities of the outline of the impression and the crystalline structure of the metal. The indentations in the outline of the impression appeared on thoroughly annealed samples where the structure of the metal was quite uniform, but where the casting had received no mechanical treatment; on the other hand, this was not the case on rolled samples of metal in both the hard and annealed condition. It seems likely, therefore, that the indentations in the outline of the impression are caused by minute holes in the metal rather than by its crystalline structure, but as neither explanation indicates a means of eliminating the difficulty, the fact remains that it is necessary to make three or four measurements of the impression in order to secure a trustworthy average value.

Difficulty arises from the fact that unless the metal is annealed, hardness tests on castings are likely to show varying results on different parts of the same casting, owing to the differences in the speed at which the metal cooled. In cases where it is desired to determine such variations in the hardness of a casting, the Brinell method of testing affords a very satisfactory means of investigation; but where the hardness test is conducted to determine an average value of the hardness of the entire casting, this variation is naturally objectionable, as it makes it difficult to secure a fair average value. For these reasons the results of hardness tests of castings are likely to be unreliable, but the tests offer a convenient means of securing information regarding the general characteristics of the metal.

Another useful application of the hardness test is in cases where castings of similar appearance but composed of different metal mixtures have been accidentally mixed. The application of the hardness test enables such castings to be rapidly sorted out or identified, and the method is far more rapid than a chemical test. Furthermore, the hardness test does not interfere with the subsequent use of the pieces on which the tests were made. In such cases, the difference in hardness of the parts is usually so marked that a ready means of identification is afforded. For instance, pure annealed aluminum will show an impression of at least 5 millimeters diameter, while an alloy containing 97½ per cent aluminum and 2½ per cent copper shows an impression of only 4 millimeters diameter.

Testing of Mill Products

A useful application of the hardness test of non-ferrous metals is in the investigation of the influence of mechanical and thermal treatment on such materials. Any mechanical treatment increases the ultimate strength and hardness of the metal, while the ductility is reduced; the application of heat

has the opposite effect, making the material weaker and softer but more ductile. The hardness test affords a convenient method of determining slight differences in the process of manufacture, and it is an easy matter to establish standards that may be used in checking up the work of the factory. As it is of the highest importance to obtain exactly the required values of the different physical properties just referred to, in order to make the metal suitable for different purposes, the application of the hardness test as a means toward this end is of considerable value. Data obtained from hardness tests have also been employed in investigating the influence of different methods of annealing, in determining the most advantageous duration of the annealing operation and in deciding upon the best temperature to employ, the advantage being that the test serves to eliminate variations resulting from the personal equation.

Hardness tests may also be profitably employed as a means of guidance in the purchase of factory supplies. For instance, sheet metal is frequently ordered in various degrees of stiffness, specifications being made according to an arbitrary scale of ¼ hard, ½ hard, or ¾ hard; or a sample of metal may be submitted with an order calling for duplication of the sample. The old method of determining the quality of the metal delivered to the factory was to bend the samples by hand in order to estimate their flexibility. The results of such a test were necessarily unreliable, and the substitution of the hardness test eliminates the factor of personal judgment, in place of which a definite scale is substituted. If complete standards are established, the test definitely indicates whether the material complies with the required standard. In case the material does not comply with the standard, the test also indicates the treatment which is necessary to bring it to such a condition. Table I shows an example of standards developed in one factory for use in testing aluminum plates which are rolled down from the same size slabs to a thickness of 0.04 inch. The method of treatment differs in each case and the upper line of the table shows the thickness of the plates at the time the final annealing operation was performed, while the lower line shows the diameter of the Brinell impression, in millimeters, for a test made on the finished plate. These figures are of particular value where the metal is to be drawn up into cups and similar products. When it is desired to duplicate material, and data of this kind are available, it is an easy matter for the mill to produce the desired results. While the data presented in Table I happen to be for aluminum plates, similar figures may readily be developed for copper and brass.

Another application of the hardness test is shown by the following: The diameter of a rod of electrolytic copper was reduced by cold drawing from 1½ inch to 1⅜ inch; then it was tested at different distances below the surface, as shown in the diagram which accompanies Table II, and the results of the hardness tests are shown in this table. The results clearly show that the drawing operation has the greatest effect on the physical characteristics of the metal near the surface of the rod, but that even a comparatively slight reduction of the diameter by drawing—as in the present case—does affect the properties of the metal at the center of the bar. That the difference between the properties of the metal at different distances from the surface cannot readily be determined by other methods is clearly shown from the results of the following experiment: Standard tensile test bars were taken from the same copper rod and turned to diameters of 1¼ inch, 1 inch and ⅝ inch, respectively, the purpose being to remove different amounts of metal from the surface. It might readily be expected that when these bars were subjected to a tensile test they would show differences in ultimate strength, but as a matter of fact all of the bars were broken by the application of the same unit stress.

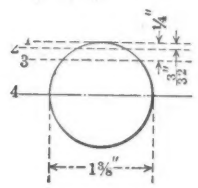
TABLE I. HARDNESS OF ALUMINUM SHEETS 0.04 INCH IN THICKNESS

Thickness of sheets when annealed for the last time, inches	0.20	0.15	0.12	0.10	0.08	0.06	0.05	0.04*
Diameter of impression made by ball, millimeters	4.00	4.15	4.25	4.35	4.45	4.50	4.70	5.20

Machinery

* Dead soft.

TABLE II. HARDNESS OF COPPER ROD AT DIFFERENT LEVELS, SHOWING EFFECT OF DRAWING



Level No.	1	2	3	4	Test on Annealed Metal at any Level
Diameter of impression made by ball, millimeters	2.85	3.05	3.15	3.25	3.55

Machinery

This result is striking and might reasonably lead one to believe that the result of one or the other of the methods of testing is not reliable, but the true explanation lies in the fact that fibers which are in various conditions of hardness impose stresses upon each other, thus destroying a portion of their resistance against the action of exterior forces. In this way part of the strength due to hardening the outer layers of the metal is lost. Practical advantage may be taken of the results of this investigation in connection with the manufacture of hard drawn brass rods. Rods made of certain metal mixtures are likely to develop cracks at the surface, and such cracks may appear months after the rods are finished. The trouble is due to the stresses which are developed between the outer layers of metal and the core, and as these stresses are proportional to the local differences in hardness, it is possible to make hardness tests which will determine whether the variation in the stresses exceeds safe limits. The tests may be made right in the mill after the last drawing operation has been completed, thus saving trouble if the material proves defective after it has been delivered to the consumer.

In addition to tests of the character previously referred to, this method of testing may often be employed to indicate slight differences in quality. For instance, sheet metal which shows impressions of uniform diameter at various points on its surface is composed of metal of more uniform composition than is the case where the diameters of the impressions show considerable variation. Both of these conditions are often found in the case of aluminum plates, and metal in which the diameters of the impressions are uniform will be found to possess the highest degree of ductility, even if the average hardness is the same in both cases. The same is true of copper sheets. The ultimate strength of the metal in heavy copper sheets appears to depend on certain properties of the material which are not yet clearly understood, but the strength of the material is found to be in direct proportion to the regularity of the diameters of impressions made in conducting the Brinell hardness test. From the foregoing it will be evident that this method of testing is a valuable guide for both producers and users of various classes of metal.

A peculiar condition is revealed by the fact that there is sometimes a tendency for the hardness test impressions to be elliptical in shape rather than round. Such impressions are usually formed where the material has been subjected to severe mechanical treatment in one direction only, and they are usually found in cold-rolled sheet metal. The differences between the long and short axes of the impression afford an indication of the amount of cold treatment to which the metal has been subjected; for example, if an aluminum sheet shows considerable hardness, it may be judged from the appearance of the impressions whether it is pure hard rolled aluminum, or an alloy in which the hardness is due to the chemical composition of the metal rather than to the mechanical treatment to which it has been subjected. It is interesting to note the relation which exists between the dimensions of these ellipti-

TABLE III. RELATION OF HARDNESS, TENSILE STRENGTH AND PER CENT ELONGATION

	Length of Long Axis of Elliptical Impression made by Ball, Millimeters	Tensile Strength, Pounds per Square Inch	Elongation, Per Cent
In same direction that rolling was done....	3.55	53,480	4
In opposite direction to that in which rolling was done.....	3.42	57,680	4

Machinery

cal impressions and the other properties of the material, and Table III shows the results obtained in testing a piece of sheet copper 1/16 inch in thickness. Referring to these data it will be noticed that the strength of the material in the direction of the fibers is less than its strength across the fibers. Similarly, the larger diameter of the impression indicates a lower degree of hardness and strength, and is usually found in the direction in which the rolling was done.

Wearing Tests

It might reasonably be supposed that the resistance which the metal shows to wearing by friction bears a definite relation to the hardness of the metal, but experiments have shown that this is not true. At least there is no well defined relation between the properties which are revealed by the tests commonly employed to determine the hardness of the metal and its resistance against wear, although both of these properties can be said to constitute the hardness of the metal. From the results of a number of such tests, one striking example may be quoted. A certain exceptionally hard copper alloy showed an impression 2.90 millimeters in diameter when tested by the application of a load of 1000 kilograms, while a plain gun-metal showed an impression 4.70 millimeters in diameter when similarly tested. These figures would naturally lead to the belief that the gun-metal was a much softer metal, but a wearing test conducted for both materials showed that the gun-metal possessed twenty times as much resistance against wear as the copper alloy. As neither the Brinell apparatus nor the scleroscope can be used for determining resistance against wear, information on this point has to be obtained by special apparatus. Probably the most satisfactory machine for conducting this class of tests is the one which has recently been developed in the Belgian steel mill of E. G. Derihon.

* * *

RESISTANCE OF FIREBRICK*

The average person and some who should know better have exaggerated ideas of the temperature to which their bricks are subjected in their furnaces, especially when not checked up by pyrometers. I have in my files of catalogues of refractories many statements made by manufacturers that their brand of brick will withstand temperatures from 4000 degrees F. up. Being modest, few claim over 7000 or 8000 degrees(!), but I am glad to say that the average manufacturers are becoming more and more conservative in their statements. The best results obtained by the Bureau of Standards in determining the melting points of fifty-six samples of the best brands of fireclay brick showed but one fireclay brick which withstood a temperature of 3135 degrees F. before it melted. The average was considerably under 3000 degrees F.

* * *

Iron ore production of the United States increased 14,000,000 tons in 1915, according to figures recently made public by the United States Geological Survey. The iron ore mined in 1915 was 55,526,490 gross tons, and its average value was $1.83 per gross ton. It is estimated that the production of iron ore from the Lake Superior district alone in 1916 will be nearly 60,000,000 tons and that it will net an increase in price of from seventy to seventy-five cents a ton. The production of pig iron was 29,191,600 gross tons in 1915.

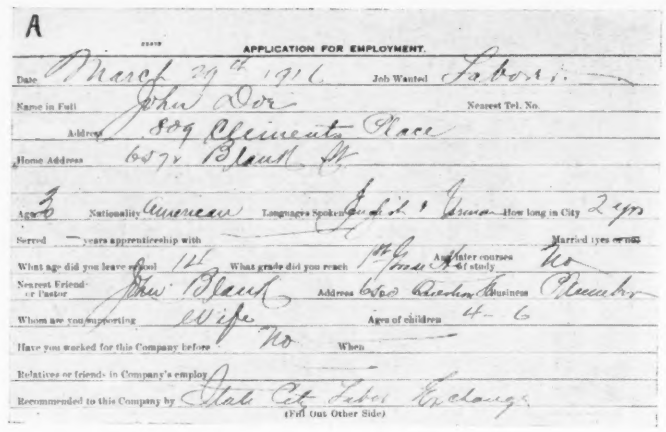
* Extract from paper "Tests on High-temperature Furnace Cement," by W. S. Quigley, read before the Philadelphia Foundrymen's Association, May 3, 1916.

EMPLOYMENT OFFICE SYSTEM

BY H. SUNDERMAN*

The following describes a system used by the writer in managing a factory employment office, and the results obtained have been very satisfactory. We have a spacious waiting room adjoining the employment office and this room is furnished with comfortable armchairs and writing tables with pencils, pens, ink and application blanks for the use of those who are anxious to obtain employment with our company. As each applicant enters this waiting room the first thing that attracts his attention is a notice hung in conspicuous places, printed with large black type on cards 7 by 11 inches. This reads: "Fill out your application completely and answer all questions or it will not receive proper consideration. If you need any assistance the clerk will gladly help you."

After reading this notice the applicant immediately fills out both sides of the card reproduced in Figs. 1 and 2; and after this has been done the form is presented to one of the employment office clerks, who asks the applicant questions, upon the result of which he is given a grade of from


A

APPLICATION FOR EMPLOYMENT.

Date March 29th 1916 Job Wanted Laborer

Name in Full John Doe Nearest Tel. No.

Address 809 Clement's Place

Home Address 6872 Blank St.

Age 36 Nationality American Languages Spoken English & German How long in City 2 yrs

Served — years apprenticeship with Married (yes or no)

What age did you leave school 14 What grade did you reach 7th Grammar Any later courses of study No

Nearest Friend or Pastor Rev. Blank Address 6872 Blank Ave Business Member

Whom are you supporting Wife Ages of children 4 - 6

Have you worked for this Company before No When

Relatives or friends in Company's employ

Recommended to this Company by State Ct. Labor Exchange

(Fill Out Other Side)

Fig. 1. Front of Card used to record Applicant's Qualifications

A to G according to the nature of his replies. The following shows the qualifications for the different grades.

A—Good appearance, strong, healthy, active, and possessed of all qualifications required.

B—Disposition appears satisfactory, bright, polite, but does not appear to be in the best of health.

C—Slow and awkward.

D—Appears to be older than age given.

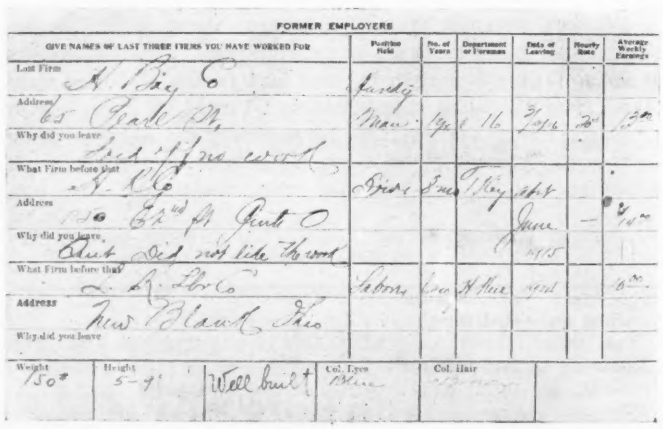
E—Previous employe of our company with past record not of the best; if re-hired, caution man about future conduct and attendance.

F—Result of questioning makes it appear that man would be a disturber.

G—Not truthful or appears to be a heavy drinker, loud and boisterous; in other words, don't hire this man.

If there are no vacancies at the time application is made, the applicant is so informed and his card is filed according to the class of work desired; then when there is a vacancy those who have the best qualifications are notified.

* Address: 4224 30th St., Oakley, Ohio.

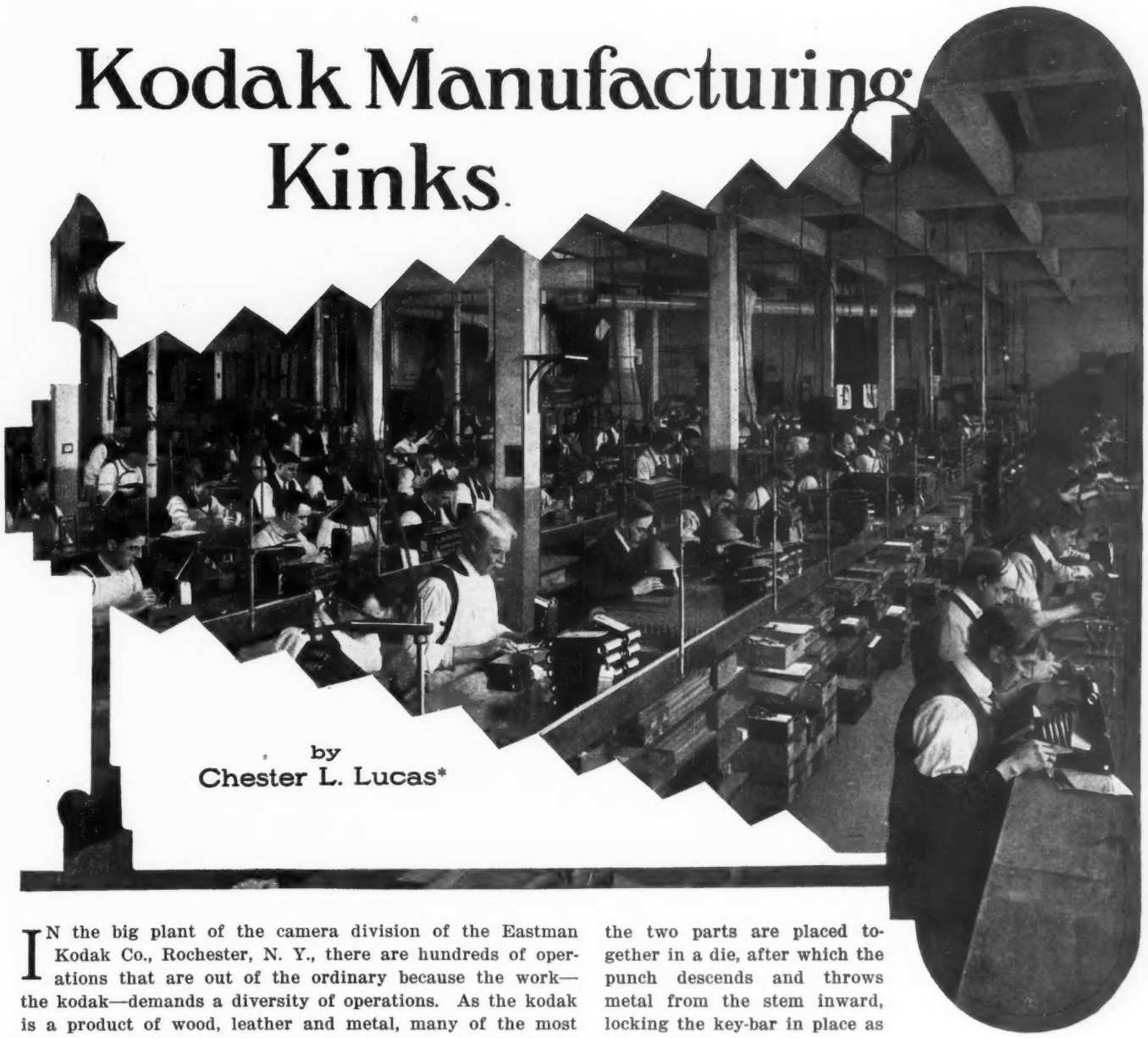

FORMER EMPLOYERS

GIVE NAMES OF LAST THREE FIRMS YOU HAVE WORKED FOR	Position Held	No. of Years	Department or Foreman	Date of Leaving	Hourly Rate	Average Weekly Earnings
Last Firm A. Bay Co.	Foundry					
Address 65 Clark St.	Mach.	4yrs	16	3 yrs	35	15.00
Why did you leave Lack of Iron work						
What Firm before that A. Bay Co.	Brass	2 mo	Bay	1916		
Address 210 E. 2nd St. Port O.				June	—	2.50
Why did you leave Did not like the work				1915		
What Firm before that L. L. Lee Co.	Laborer	1 yr	11 mo	1914		10.00
Address New Blank Ave.						
Why did you leave						

Weight	Height		Col. Eyes	Col. Hair
150#	5-4	Well built	Blue	Brown

Fig. 2. Back of Card on which is recorded Applicant's Past Experience

Kodak Manufacturing Kinks



by
Chester L. Lucas*

IN the big plant of the camera division of the Eastman Kodak Co., Rochester, N. Y., there are hundreds of operations that are out of the ordinary because the work—the kodak—demands a diversity of operations. As the kodak is a product of wood, leather and metal, many of the most ingenious operations, such as the covering of the bellows with leather, are not strictly in MACHINERY'S field, but a few of the kodak kinks that are of general interest are here presented.

Rivetless Assembling

Figs. 1, 2 and 3 represent three different assembling "wrinkles" used for joining cross bars to the posts of spool keys. In every case the joint is made without the use of rivets, and in fact the rivet-metal is "stolen" from the post itself. In Fig. 1 the round bar is dropped from the screw machine with a shallow grove cut at the center. The key-post is cut from the bar with a cutting-off tool that leaves a little projection in the center of the end. The assembling of the two parts consists of slipping the bar through the post and giving the top of the post one sharp blow with a hammer. This drives the projecting metal down into the groove in the bar and securely locks the two parts.

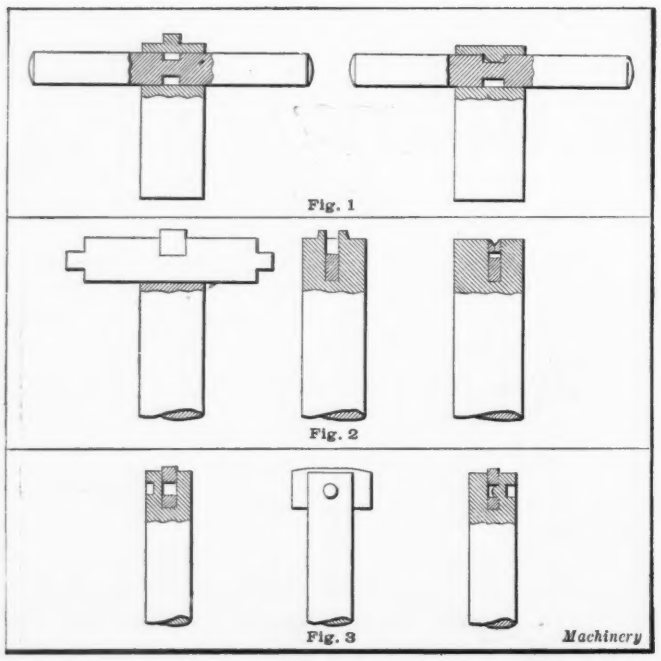
Fig. 2 shows how a flat bar is joined to a key-post without rivets. The key-post is cut off so that a projection is left on the end, and is then slotted to receive the flat bar. This bar is blanked with a recess at the center, and when put together the two pieces appear as in the center illustration of Fig. 2. To rivet, the assembler merely drives over the two lugs that were formed when the central slot was milled through the key-post center projection. These lugs fill the space.

Still another method used for joining two similar parts is shown in Fig. 3. The bar is prepared with a punched hole; the two parts are placed together in a die, after which the punch descends and throws metal from the stem inward, locking the key-bar in place as shown in the last view.

An Eccentric Screw Machine Job

One of the excellent screw machine jobs done in the Eastman Kodak Co.'s screw machine department is the making of the brass bed brace stud that is shown approximately full size in Fig. 7. The set-up of the screw machine for producing this part is illustrated in Fig. 4. The hexagonal brass rod from which this stud is made is 5/16 inch diameter across flats. It will be noticed that the threaded section is eccentric to the remainder, its location being about 1/32 inch off center. The stock is held in a hexagonal collet and the threaded eccentric section is outermost on the bar. The method of cutting the eccentric is to offset the turret tools required for the eccentric machining; these tools are rotated, of course, as they must work on the stationary bar. After the stock has been fed to the stop at the first turret position the spindle is stopped, and the turret indexed to bring it to the second position. Here a box milling tool machines the bar down to the thread diameter. Then the turret is again indexed to bring into position a tool that chamfers the shoulder back of the thread. The turret indexes once more, bringing the threading die into position and cutting the thread. The next indexing of the turret brings the pointing tool that cleans off the end of the screw into position. The spindle is now rotated and the front forming tool advances in the usual manner and feeds into the rotating bar to form the concentric section of the stud back of the thread. The final step is cutting off the completed stud with the rear forming tool.

* Associate Editor of MACHINERY.



Figs. 1, 2 and 3. Methods of assembling Kodak Spool Keys without Rivets

Bending on a Screw Machine

Another of the unusual screw machine jobs done in this plant is the making of the plate-holder slide locks. This plate-holder slide lock is made of brass wire 0.100 inch thick and the extreme end is reduced and drilled as shown in Fig. 8. It will be readily appreciated that the actual machining on this job is not difficult, but the interesting part is the fact that the work is bent as a part of the operation, and it drops from the machine turned, cut off and bent, complete. The tools for doing this job are shown in Fig. 5, and consist of the cutting-off tool *A;* the turret bending tool, one side of which is shown at *B* and the opposite side at *C;* pusher block *D* that goes on the front turret slide; and rocker arm *E* for operating the turret tool. At the center of the illustration is shown one of the slide locks made

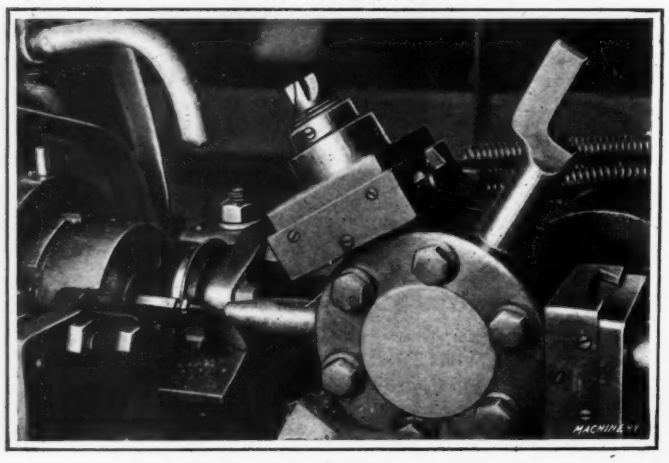


Fig. 4. Producing Eccentric Screw shown in Fig. 7

with these tools. The tools for reducing the diameter and drilling the hole are very simple and are not shown.

The bending tool shown at *B* and *C* is fitted for the turret of the screw machine and carries a hinged yoke with a roller at the outer end. The drilling and forming is done first and then the bending tool is presented to the work. The wire passes to one side of the roller arm and at the right point the arm is moved against the wire and makes the bend. This is done by the action of the front turret slide, carrying block *D* that acts on the cam on rod *E* and swings the bending tool through its connection with it.

A Press Job from the Screw Machine

In turning out the brass tripod nut illustrated in Fig. 9, an interesting use of the screw machine is in evidence for throwing up lugs by punching. The machining operations on this part, except for the punching, are comparatively simple, and after feeding to the stop, consist of forming, centering, drilling and counterboring. Just before cutting off, the upsetting operation takes place. It will be seen that the four lugs of the part are thrown out from a turned shoulder. The punch has four chisel-like projections for doing this work. It is held in the turret like any turret tool, but is mounted on a bearing and is free to rotate. After the other turret tools have done their turning, this punch comes forward in the same way and the turret advance carries it into the work and throws up the four lugs. As soon as it "bites" into the work it turns freely with it and thus does not upset the stock except at the four points desired. The operation works out very successfully and is no more complicated nor troublesome than any screw machine operation.

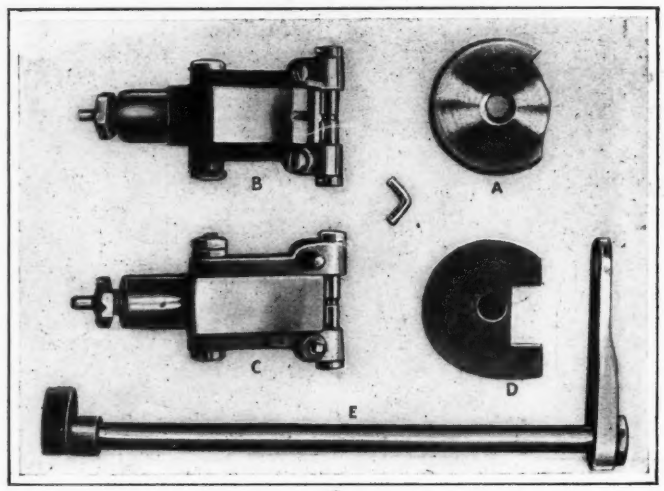


Fig. 5. Screw Machine Tools for making Bent Slide Lock shown in Fig. 8

Piercing Spool Center Eyelets

The spool center eyelet for a kodak is shown in Fig. 10. This is a brass shell ⅜ inch diameter and about the same length, and the operation to be described here is the punching of the slot through the 0.020-inch wall.

Fig. 12 shows the punch and die used for this work. The die is in the form of a stud having the shape cut through it with the necessary clearance. This is held in the side of a block on the die base. The stud is long enough to reach through the eyelet and its end is supported by a short post as shown. After the work is in place on the stud it is held there by the long lever shown. The end of this lever fits into a spring catch that holds it firmly while the piercing is being done. The punch, shown at right, has a projection that fits into a non-cutting part of the die and supports it before it begins to cut. The punchings drop through the stud and pass through a hole in the die base.

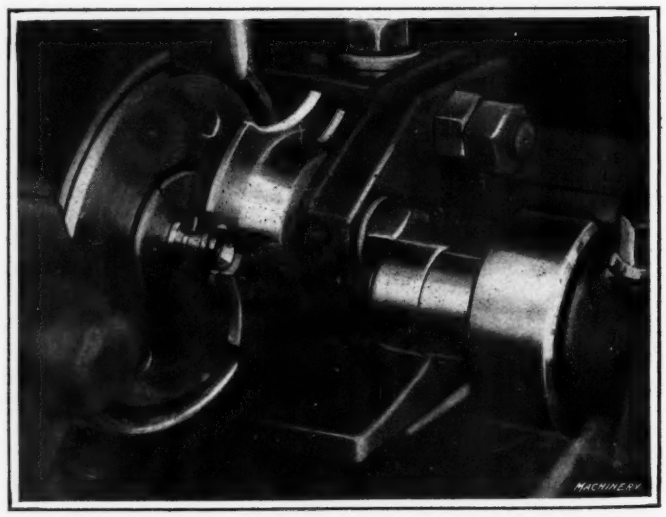


Fig. 6. Punching Tripod Nut shown in Fig. 9, on Screw Machine

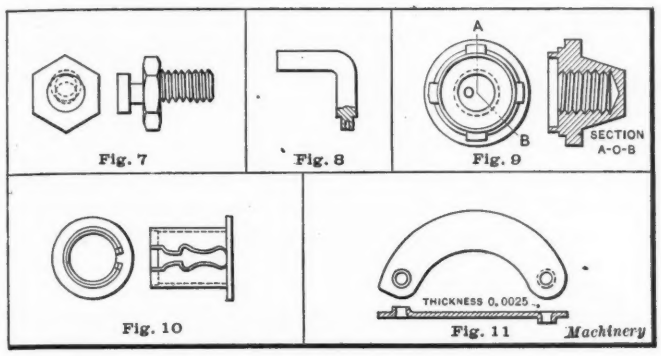


Fig. 7 Fig. 8 Fig. 9 Fig. 10 Fig. 11

Fig. 7. Eccentric Screw; Fig. 8. Plate-holder Slide Lock; Fig. 9. Tripod Nut; Fig. 10. Spool Center Eyelet; Fig. 11. Diaphragm Wing

Blanking Bronze 0.0025 Inch Thick

In making diaphragm and shutter wings the thinnest of bronze punchings have to be produced. A common thickness for such parts is 0.0025 inch. To make a die for this class of work and to keep it cutting free from burrs is a real job. A good instance is the production of the diaphragm wing shown in Fig. 11. The thickness is 0.0025 inch, but it is greatly exaggerated in the illustration to show the way in which the metal is drawn up around one hole and down around the other.

The die and punch used are shown in Fig. 13. These are sub-press in type and because of the extreme thinness of the metal and consequent danger of shearing, they are guided by four heavy sub-press pins at the corners. The stock is used in ribbon form, being fed from front to rear of the die through the gage pins that may be seen on the die at the left. Inasmuch as the metal is drawn into a bushing form around each hole, the piercing punches must draw as well as cut. As the metal is drawn up around one hole and down around the other, one piercing punch must work from above and the other from below. The stock is fed to these dies and the scrap removed by power roll feeds, and the blanks are cleared from the die with a jet of compressed air.

* * *

Nickel-chromium alloy is largely used for the resistance coils of electrical heating apparatus. This alloy has a peculiar physical characteristic when heated to the rolling heat as regards water. An ingot at a bright red may be laid in a shallow pool of water without sissing or causing steam to rise in appreciable amount. This phenomenon may be noticed in rolling the ingots where they fall into the water used to cool the necks of the rolls. What is the reason that this alloy acts so differently from steel at the same temperature when immersed in water?

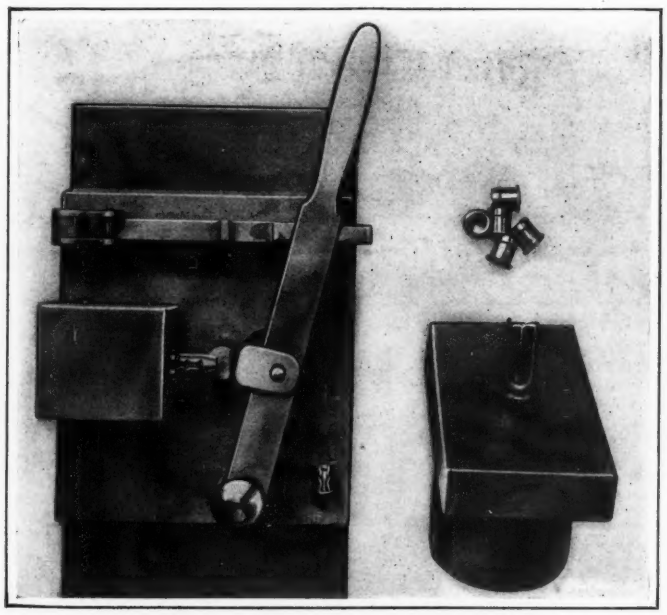


Fig. 12. Piercing Tools for Spool Center Eyelet

SPECIALIZATION CARRIED TOO FAR

BY ERIC LEE*

An incident came to my attention a few days ago which appeared quite amusing at first, although subsequent consideration showed that it was really no laughing matter. In a certain plant Jack Robertson had made all of the cutters used on a special class of wood turning machines for the last twenty years. The price paid for them was $3.25 each, which was established when the standard toolmaker's rate was very low. From 200 to 250 of these cutters were required every year, and they were usually made up in lots of twenty or twenty-five at a time. When some of these cutters had to be made the tool-room foreman invariably gave the work to Jack Robertson, as he had "specialized" on this job and it was thought that he could do it cheaper than any of the other men.

One day while Robertson was away, it was found that the supply of these cutters in the store-room had been exhausted, and a rush order was sent to the tool-room to make twenty-five

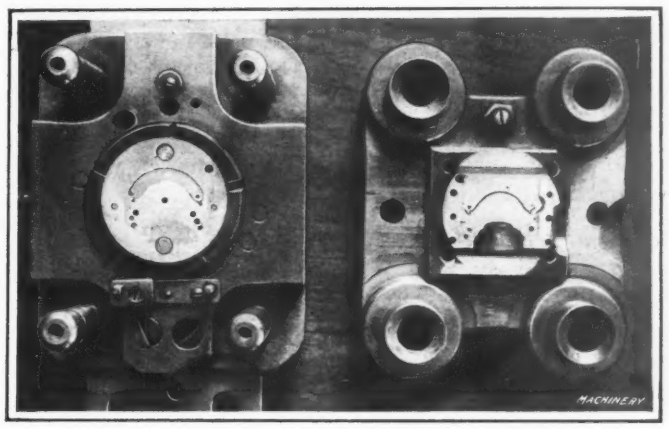


Fig. 13. Diaphragm Wing Die that punches Metal 0.0025 Inch Thick

more. This brought the tool-room foreman face to face with a crisis; he was called upon to produce twenty-five cutters at short notice, and his "specialist" on this work was away on sick leave. As all the other experienced men were also engaged on work that was wanted as soon as possible, the foreman decided that he might just as well assign the making of the special cutters to a "green" man who had just been taken on in the tool-room, it being a foregone conclusion that they would cost much more if Robertson did not do the work.

After the cutters had been finished and passed by the inspector, it naturally created somewhat of a sensation when it was found that they cost $1.75 each, notwithstanding the fact that toolmakers' wages had increased 25 per cent since the time that the original price of $3.25 was placed on this job. Taking a conservative view of the situation, the following is a comparative analysis of the cost of cutters for a year when made by the two men:

200 cutters at $3.25 =	$650
200 cutters at $1.75 =	350
Saving per year	$300

An investigation that was started to find out how this economy had been effected revealed the fact that the "specialist" had been backing off the cutters by hand, while the "green" man had looked over the requirements of the job and seen that the use of an eccentric arbor would enable the backing off to be done on the Brown & Sharpe milling machine; consequently, he made an arbor with the required 1/16 inch of eccentricity, and by substituting machine work for a hand filing operation he had made a change that was worth $300 a year to his employers.

* * *

A 500-kilowatt Westinghouse-Parsons steam turbine is stated to have been in continuous operation for thirty-two months, after which it was stopped in order to determine its condition. It was found to be in first-class shape, and was immediately started without requiring any repairs.

* Address: 191 Bassett St., New Haven, Conn.

ALUMINUM WELDING*

WELDING ALUMINUM WITH OXY-ACETYLENE FLAME

BY HARRY B. HOOVER†

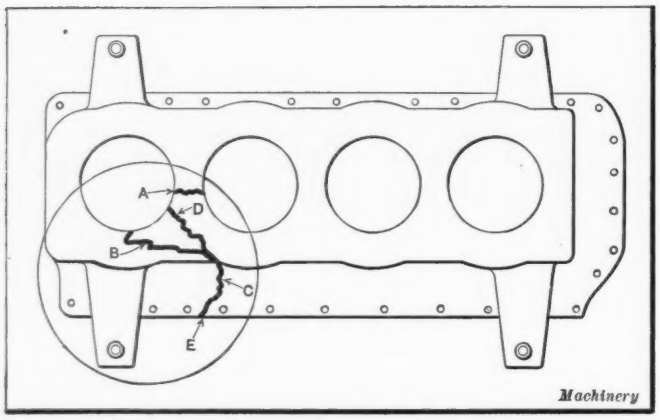


Fig. 1. Diagram showing Method of welding Broken Aluminum Crank-case

THE process of welding aluminum is somewhat difficult to learn, but it can be applied to work which would be difficult to repair by any other means. There are a number of methods in use, but the writer, after several years of successful experience in aluminum welding, has found that the following is the most successful and practical method. Some of the most difficult things to contend with in aluminum welding are the rapid oxidation of the metal, the low fusion point, rapid conduction of heat, contraction and expansion, shrinkage, and in automobile parts the chances of warping which make it difficult to keep the work in perfect alignment. The various points in connection with overcoming these difficulties will be taken up and explained separately.

Oxidation

Aluminum oxidizes very rapidly under the welding flame, the oxidation forming a film or skin over the molten metal which prevents it from flowing as freely as other metals, such as iron and steel. As the oxide melts at a much higher temperature than the metal itself, this makes it rather troublesome for the beginner. The fact that this oxide is chemically inert makes it exceedingly difficult to decompose with the flux, even at the temperature of melting aluminum. Owing to this fact, the fluxes must be chemically active, and one disadvantage of most fluxes that the writer has used is the subsequent effect on the aluminum. Many cases have been known where the metal has been seriously injured by the after effects of the flux, although some time was required for the damage to develop. It is important that the work be thoroughly brushed in boiling water to remove remnants of the flux and prevent this action after the welding has been done. Another point of importance is that after a weld has been made with flux, any crack which may later develop in or near it cannot be welded without considerable difficulty; in fact, it cannot be welded at all unless the surface has been thoroughly cleansed and the metal in the old weld has been removed.

While it is theoretically advisable to use a flux, and even necessary in welding sheet aluminum, there are other difficulties to contend with besides those mentioned. In repairing castings, such as automobile crank-cases, transmission cases, and the like, the use of a flux is difficult, principally because of the condition of the surface before welding. The importance of thoroughly cleansing any surface on which a flux is to be used, cannot be over-emphasized. However, in many cases it is not possible to do this, although the use of strong acids and alkalies, such as hydrochloric acid and caustic soda (applied to the work separately) followed by a thorough washing and brushing in hot water, will remove the dirt and grease from the exposed surfaces. It will not remove the oxide, however, nor as a general thing will it remove the grease and dirt from the crack or break, because at these points the metal is more or less porous, allowing the absorption of the grease. The absorption extends in from the break for some distance in many cases, and unless such metal is entirely cut out, the use of a flux will be found unsatisfactory. The nearer the weld, the less the contraction and distortion of the piece; hence the less metal removed, the better.

Sheet aluminum work is generally a manufacturing proposition and a flux is necessary for the proper performance of the work, but as the surfaces are cleaned, the same objections to the flux do not exist in the case of broken parts, so that the flux will make the weld just as tough and strong as the original sheet. When the metal is clean, a very small amount of flux is all that is necessary, but it must be remembered that the flux must be washed off as mentioned. In many cases a weld can be made without the use of a flux in the time taken to prepare the piece so that the flux can be used.

Puddling System

For practical purposes the puddling system is by far the best. This is accomplished by the use of a paddle made from a small steel rod flattened on one end like a flat scraper or screw-driver, and ground or filed off smooth, the edges being left sharp. As aluminum, unlike some other metals, does not change color when it becomes hot, it is necessary to watch it very closely during the process of welding, and at the time when the edges begin to fuse, the paddle is used to puddle them together. The mode of operation is as follows: First take the paddle edgewise and force it down into the molten metal along the crack or break, making sure at the same time that the metal is being welded entirely through. Now the filler rod must be used to fill up the deficiencies, the metal being kept in a molten state and the end of the filler rod rubbed into the weld, allowing the flame to come in contact with the rod and the weld at the same time. This keeps the oxide broken up and allows the metal to flow together. When enough metal has been added from the filler rod, the paddle is again brought into use, this time using the flat side to smooth the weld and rub off the surplus metal. It is essential that the paddle should be kept warm, clean and smooth, but it should never be heated more than red hot. If it gets so hot that it partly melts, it is best to replace it with a new one, a number of which should be kept on hand. When a weld is made in this way, it will be just as good as any other part of the metal, and if sufficient care is taken it can be made as smooth as the remainder of the work.

Low Point of Fusion and Rapid Conduction of Heat

The temperature at which aluminum melts is between 1100 and 1200 degrees F. With its low point of fusion and rapid

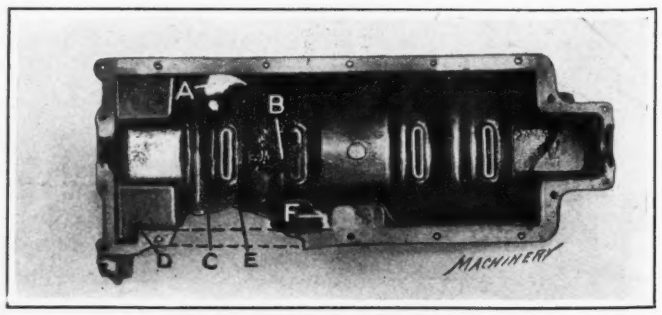


Fig. 2. Broken Aluminum Crank-case before welding

* See also "Oxy-acetylene Welding of Aluminum," June, 1916, and February, 1916, and articles there referred to.

† General Manager, Oxy-Acetylene Products Co., Chicago, Ill.

conduction of heat, it is necessary for the operator to watch it closely, and the fact that it does not change color under heat makes it still more difficult for a beginner. The greatest care must be used when preheating as well as when welding aluminum, not to get it too hot. An indication of overheating is the formation of little bright balls on the surface of the metal. This is called sweating, and when aluminum begins to sweat it is almost at the melting point. The rapid conduction of heat through the metal allows it to become molten for a large area around the point where the heat is applied almost as quickly as it does at the point of contact with the flame. By overheating a piece like this, it is possible to melt a whole crank-case into a puddle almost without warning, or to melt the side of it, or a hole in the case, according to the size of the flame being used. These difficulties must all be guarded against in order to make a successful weld in aluminum.

Contraction, Expansion, Shrinkage and Alignment of Broken Automobile Parts

The contraction and expansion of aluminum are greater than of any other metal, and it is the belief of the writer that 90 per cent of the failures in aluminum welding are due to a lack of precaution in regard to these points. If the expansion and contraction are not properly taken care of, a case which is being welded will warp or shrink out of alignment to such an extent that it is entirely useless. However, in some instances such cases can be reclaimed if not too badly damaged.

The writer remembers one case in particular which was reclaimed after it had been warped $\frac{5}{8}$ inch out of alignment and was $\frac{1}{2}$ inch short on one side and $\frac{1}{4}$ inch short on the other. By cutting the case in two and aligning it properly, allowing for shrinkage when remelted, the case was made as good as new and is now in service. The contraction and expansion are taken care of by preheating and cooling properly. The shrinkage and warping are also taken care of to a certain extent by proper preheating. The most satisfactory of all the different methods is the use of a torch, such as an ordinary blow-pipe, using city gas and compressed air, or a gasoline or kerosene burner. Each of these methods has its own good points, but either can be used with good results.

A preheating torch (as it is called by the writer) is used in preference to a charcoal fire or gas oven because the heat is under the absolute control and regulation of the operator at all times. There is therefore less chance of overheating which might cause the case to warp or shrink, and as the preheating torch is more flexible and allows the piece to be manipulated in any position, any portion or all of the case can be heated at will. It will be understood that the operator must be supplied with a helper who controls the preheating flame under his direction, and there are times when the operator could use two helpers to advantage, as will be explained subsequently. It is seldom that two aluminum castings are found to be of exactly the same composition, some having a higher percentage of zinc and some more copper, etc.; hence, they must be handled in a slightly different manner.

For example, take a case that is composed of an alloy having a high percentage of zinc which melts at a lower temperature and is more brittle and soft when at a high temperature; it shrinks more under certain heat conditions and is therefore more likely to get out of alignment from overheating and to crack in contracting and expanding. In welding a case of this kind, it is extremely important not

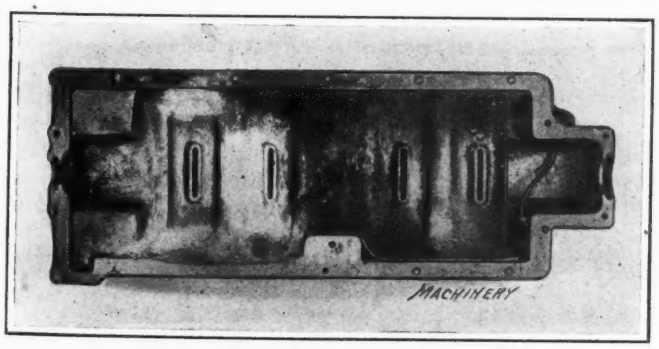


Fig. 3. Case shown in Fig. 2 after welding

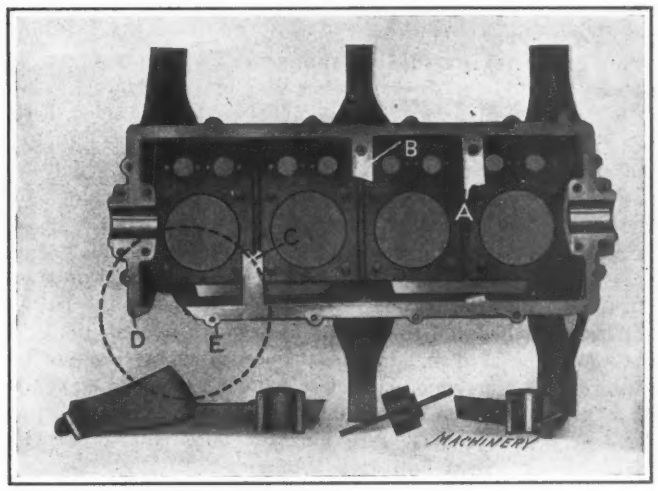


Fig. 4. Example of Badly Broken Aluminum Crank-case

to preheat any more of the case than is absolutely necessary, and even this work must be done as quickly as possible. By using the preheating torch in a case of this kind, the work can be accomplished quicker, better, and with greater economy than by any other process, so that it is much more practical for general use.

Welding a Broken Aluminum Crank-case

An explanation will now be given of the method used in welding the crank-case shown in Fig. 1. In the first place, the case should be thoroughly cleaned, removing all grease and dirt, especially around the end to be welded. The next thing is to see what condition the case is in; if it has been twisted or sprung out of alignment, it will be necessary to pull or force it back into shape with clamps and straightedges. One straightedge should be placed along the bottom of the case where it is bolted fast to the under side, and very small clamps should be used, say, 2-inch C-clamps.

The straightedges should be of cold-rolled steel about $\frac{3}{8}$ by 1 inch, and should be a little longer than the case. In putting on a straightedge it should be clamped edgewise, instead of using the flat side, which gives it more strength so that it is less likely to warp under the application of heat. The clamps should not be drawn up very tightly, enough force being used to draw the case up to the straightedges, using the hands only. If a wrench is used and the clamps pulled too tight, the case may be smashed or pulled out of shape where the clamps rest against it, especially near the point at which the heat is applied, as the heat softens the aluminum as before mentioned. At least two more straightedges should be placed on this case, one at the top where the cylinders bolt on, which should run the full length of the case, and one under the two arms shown, fitting in the same as the frame members of the car to which the case would normally be fastened. After the case has been properly aligned and the pieces put in place, it is ready to be preheated. The first step in preheating is to warm the case all over just enough to take off the chill, after which the preheating can be confined to that part where the fractures have occurred, as shown at *A*, *B*, *C*, *D* and *E* in Fig. 1. It is assumed that the devices for preheating are the same as those recommended herewith. In starting the work, the arm should be preheated gradually, extending the heat around over the area shown inside the circle, watching it very closely and keeping the arm hotter than any other part of the case. By using a paddle, as recommended previously, to scrape or "feel" the aluminum in this way, it is easy to tell when the case is hot enough to commence welding. By scraping the aluminum with the edge of the paddle where it

is cold, it will be noticed that the metal is hard and the paddle will slip across very easily, hardly leaving a mark, but when the aluminum becomes hot, the paddle digs right in, and when this condition is reached it is time to begin welding. The preheating flame should be kept on the arm during the entire operation, keeping it at about the same temperature all the time. It is possible for one man to do this work if he is properly equipped, but two men can do it much easier and obtain better results. In explaining the method, however, let us consider that the work is being done by one man.

In the first place, the fracture at *A* would be welded, a tip being used just large enough to bring the metal into a molten condition, having the flame absolutely neutral. After the metal has started to fuse or melt, take the paddle edgewise and force it down into the crack or break, in this way breaking up the oxidation and allowing the metal to flow together. It may be necessary to dig out some of the metal along the crack in thick places to get to the bottom of the fracture. After the bottom has been reached and the metals have amalgamated, the filler rod should be used and the deficiencies filled up, keeping the edges of the metal molten and stirring with the filler rod so as to keep the oxide broken up and allow the metals to flow together. The greatest care must be taken not to get the metal too hot, as it will drop through or collapse, leaving a hole which will require much more work to fill up. This could be avoided by lifting the flame for an instant, allowing the metal to cool partially and at the same time working it with the paddle or filler rod; as it cools, again apply the flame, bringing it up to a molten condition, work it for a few seconds, and then lift the torch once more. This process should be kept up during the entire operation, although, of course, when the parts are heavy, they do not need to be cooled so often, but when the metal is thin, it is absolutely necessary that it be allowed to cool in this manner. The under side of this weld should be smoothed up just before commencing to fill in with the filler rod, and should not be touched subsequently.

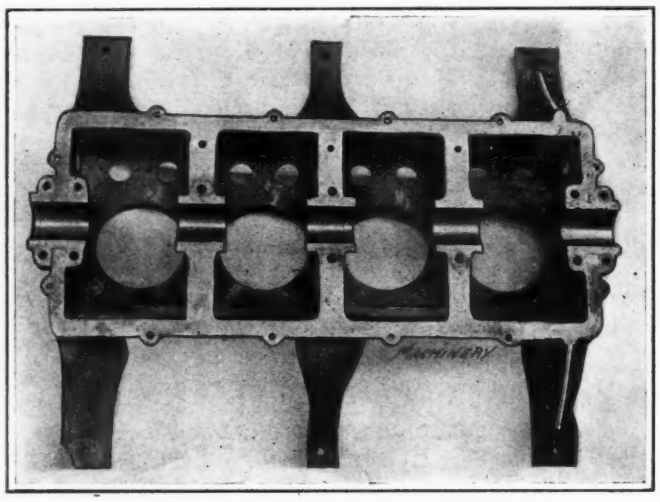


Fig. 5. Case shown in Fig. 4 after Repairs have been made

Fracture *B* is the next weld to be made. This portion of the work should be started at the inside edge and welded down to the fracture *C*. To get at the bottom of this weld, it will be necessary to go down through from the upper side, welding about 1½ to 2 inches in this manner. Then smooth up the weld on the under side, keeping up the process until the work is completed. A point of considerable importance in connection with the welding of this piece is that fracture *C* has been left open during the previous operation, thereby allowing the case to contract and expand without throwing any strain on the welds. It will be necessary, before beginning to make the last weld, to preheat the case as before, after which weld *C* can be started, beginning at the inside edge or top of the case as indicated by *D* and welding down to the outside edge *E*, carrying out the work as directed for the previous operation. After turning the case or straightening the weld up on the inside, it would be advisable to use the preheating torch again for a few seconds in each instance. After the weld has been finished, the preheating torch should be kept on the arm until the weld has become as cool as the surrounding metal; then the hole should be covered with asbestos and allowed to cool in this manner.

Aluminum should never be welded from one side only, except in rare cases, such as welding small lugs, magneto stands or similar parts where the expansion and contraction would take care of itself and would not put any strain on the body of the case. In welding aluminum from one side, the operator should have a helper, and the case should be placed in such a position that both sides are conveniently accessible at the same time, the operator working from the outside and welding all the way through, while the helper uses a paddle on the inside. Then when the metal has been brought into a molten condition on the inside and the two edges of the fracture are puddled together by the helper and smoothed off, they can be kept that way until the weld is finished on the outside. In this way the metal is welded all the way through and finished up at the same time, which saves time and makes a strong weld. After the weld has been made half way through from one side, the piece is turned over and finished from the other side as in ordinary cast-iron work. It is almost impossible to make a first-class job of it, as this method causes unequal contraction and expansion, and the metal cracks or shrinks to such an extent that the case is warped out of alignment. If the job is a large one and requires a long time to weld, a second helper is sometimes necessary to handle the preheating torch. In this way the operation can be carried straight through without the loss of time caused by stopping to preheat occasionally.

Welding a Difficult Crank-case

The case shown in Fig. 2 is a rather difficult job, since it has a false or double bottom, and it is hard to keep the two bottoms expanded evenly; it will also be noted that the parts which are broken out of the case are entirely missing. To fill in the missing parts, the best method known to the writer is to form a piece of sheet iron to fit the case on the outside, covering the broken out place and making it fit snugly. The outer edge should be flanged in the same way as the case and clamped in such a position as to assist in making the mold. A mixture can be made of plaster-of-paris and ground asbestos, just about as thick as mortar, and then poured into the mold. The mold should be filled a little more than even with the case, so that when it dries it will still be thicker than the case. After this piece has been dried out, it can be used for a pattern from which a casting can be made at the aluminum foundry. If there is no foundry of this kind in the vicinity, a ladle of melted aluminum can be used and the mold poured as nearly full as possible, after which it is allowed to cool. After this has been done, the hollow places can be filled in with the filler rod when welding. The former method is by far the more practical except in small openings, when the latter method is better.

When welding the case shown, two straightedges are used, one along each side, the full length of the case. The pieces that have been cast are fitted into place and clamped or fastened so as to hold them in alignment. The case is preheated all over until the chill has been taken off and then the preheating is confined to the parts adjoining the surfaces to be welded, using the preheating equipment previously mentioned, and playing the flame first on the inside and then on the outside so as to expand the double bottom evenly. The weld at *A* is made first (by the two-man system, as we may call it), and the preheating flame should be kept on the case all the time. The weld at *B* is next made entirely from one side, as it is impossible to get at it from the other. The flame is kept on the underneath or outside during the weld at *B* so as to keep the bottom half fully expanded. Weld *C* is made next. This should be spot-welded or tacked at the corner *D* and then at the center of the weld *E*. The weld is started at point *F* and continued up to the top of the case and around weld *C*, finishing at *D*. Fig. 3 shows the case after the repairs have been completed.

Welding a Crank-case with Broken Out Bearings

Fig. 4 shows a badly broken crank-case and Fig. 5 shows the case after it has been repaired. In preparing to weld this case, the babbitt should first be removed from the bearing, and a mandrel should be made of steel tubing the size of the bearing and as long or longer than the case, for aligning the broken out bearings and holding them in place during the entire operation. One of the important things to consider in a piece of repair work like this is the shrinkage, and sufficient allowance must be made to take care of this. By placing a thin sheet of asbestos 1/32 inch thick under the mandrel at the two end bearings, the center bearings will be raised 1/32 inch higher than their original position, which is sufficient to take care of the shrinkage. It is, of course, necessary to place the bearing caps in position just as if the crankshaft were being put into the crank-case, so as to hold all bearings and mandrels in proper alignment. After placing the bearings in position for welding, it is necessary to preheat the case sufficiently to take off the chill, as already described, but an extensive preheating of this case is not necessary. The first weld to make is the bearing at *A*, this being tacked at one side and then welded on the other side around to the first tack. By using a helper on this job, it is done more rapidly and with much better results. The bearings *B* and *C*, respectively, are next welded the same as bearing *A*, and as each weld is made the bearing caps should be loosened to allow the bearing to settle into its original position. The mandrel used for aligning, however, should not be taken out until the case is finished and is perfectly cold. In welding the arm, it should be placed in position and clamped there with straightedges, one of which is placed on the bottom of the case where the bottom half is bolted, one on the top where the cylinders bolt on, and still another one on the outer edge of the arms. All straightedges should be the full length of the case.

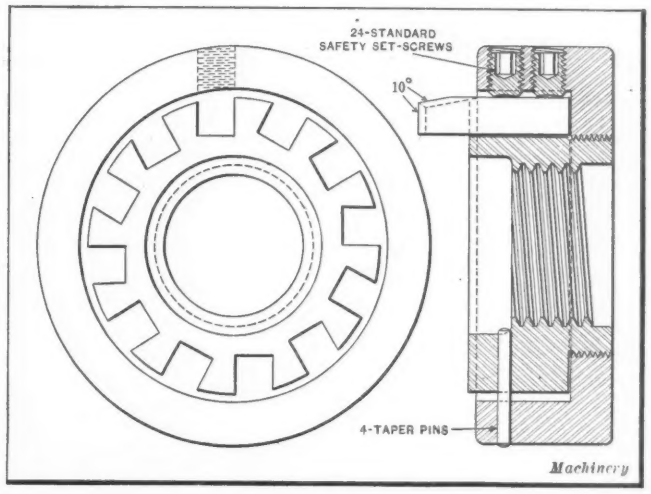
The case is now ready for preheating, the heat being confined to that part of the case shown inside the circle; then the heat is brought up gradually, keeping the arm hotter than the body of the case and leaving the preheating flame on the arm during the entire operation. This weld should be started on the outside edge as shown at *D*, then the inside upper edge should be welded as shown at *E*, continuing around the arm the same as with the bearings and finishing at *D*. The arms should be kept hot until the weld is as cool as the surrounding metal, thus preventing strain, after which the case should be covered with asbestos and allowed to cool slowly.

It may be necessary in some cases to allow a greater or less amount for shrinkage, according to the thickness of the metal. In this particular instance, the case was about 3/16 to 1/4 inch thick. In preheating and cooling, as before mentioned, the shrinkage cracks are prevented which ordinarily occur when the case is preheated all over. As the weld cools before the arm does, the expansion of the arm keeps the metal from contracting on both sides of the weld at the same time. After it has cooled, it will stand as much strain as any other part of the case; so letting it cool before the arm does, makes it really stronger than the heated metal, so that the strain has really been removed from the weld and the only expansion left is in the arm. By cooling this gradually, the contraction is taken care of very readily. A case welded in this manner has not been subjected to any great danger in warping or shrinking out of alignment, as the greater part of it has not been heated very extensively, although some heat has been acquired through radiation. As the larger part of the case has been kept cool, it has held its shape and made it easier for the operator to handle; it has not been subjected at any time to the danger of collapsing from handling or from overheating. If a charcoal fire is used in preheating this case, the chances for warping and cracking are much greater, as the whole case is heated to about the same temperature, making it necessary to handle it very carefully; rough handling under this temperature might cause the case to collapse, or if it were not properly blocked up, it would easily get out of alignment, which might not be noticed until the case had been finished. In addition to this, it is inconvenient to work over a case which has been heated in this manner, on account of the extreme heat.

INSERTED-TOOTH FACING MILL

The illustration shows a facing mill in use at the Vermont Farm Machinery Co.'s plant, Bellows Falls, Vt., for facing the ends of round forgings about 3 inches in diameter. The amount to be removed from these forgings varies from ⅛ to ⅜ inch. After experiencing considerable difficulty with the ordinary solid type of face mill, a cutter was made with inserted teeth as shown, which has worked out very successfully in service.

The mill is made up of an inner ring or core that screws on the nose of the spindle. This core is slotted with twelve slots for the reception of the square tool bits which were made from ⅝-inch square high-speed steel. Surrounding the core is a ring that is threaded to the base of the core and held stationary by four tapered pins. This outer ring is for receiving the set-screws that lock the facing cutters in place. The set-screws are of the regulation safety type and are distributed two to each of the inserted teeth. The face and cutting side of each of the inserted tools are relieved to a clearance of 10 degrees in both directions.



Facing Mill with Inserted Teeth

This facing mill has proved very successful, and the milling operation is carried on with little vibration. The great amount of chip room frees the edges of the teeth of chips at all times. This cutter construction also has the advantage of permitting broken or badly dulled cutters to be replaced quickly.

C. L. L.

* * *

Specialization may be carried out in the building of one size of engine lathe with somewhat the same advantage as in building one size of motor car only. We know what a tremendous success has been achieved by one concern which has built only one size of chassis for a number of years. It has been due to developing special machinery and methods which were practicable only when a large number of cars were made. The same holds true in a lesser degree with the manufacture of engine lathes. Where lathes are built in several sizes they are put through in lots of ten, twenty, fifty or perhaps more, but no matter how many there are in a lot it is a distinct division of the production. The next lot will usually be of another size. Now if a few castings are defective—say three cones have blow-holes and are rejected—it means that three lathes are held back until new castings can be made. But if the production of one size is going through steadily, the output is not perceptibly checked because a few castings are thrown out. Of course the chief advantage is in the economies effected by the development of jigs and fixtures and time-saving methods that are feasible in quantity production.

* * *

One machine tool builder met the difficulty of getting steel forgings required for lathe spindles by putting in a Nazel pneumatic cushion hammer and forging them from old car axles. He purchased a large quantity of axles, new and used, for $1.20 a hundred-weight and turned them into high-quality spindles with the aid of the hammer.

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THE VALUE OF MOVING PICTURES IN SELECTING TRADES

Many boys waste valuable years of their lives before finally settling down to the kind of work for which they are best fitted, because they take up a trade with little knowledge of the nature of the work, and after spending months or years, reach the conclusion that they will never like it. This means dissatisfaction, loss of time, and perhaps eventual failure to find an agreeable and profitable occupation.

This state of affairs is unprofitable not only to the employe but also to the employer. It is estimated that it costs an employer from forty to sixty dollars for every employe taken on and taught the rudiments of his work. Of course, if he stays long enough to become proficient, the investment is returned with profit. But how is the employer or the employe to know that the relation will be mutually satisfactory until the employe has acquired some experience? One possible solution is to reproduce the conditions of work by means of moving pictures, and present a fairly accurate idea of the conditions of work, the surroundings, the wages earned, the types of employes and other facts of vital importance to one about to begin an occupation.

If films were available showing the conditions in the principal trades, they could be made useful not only for sifting out undesirable employes, but also for attracting to a given trade those who are naturally well fitted for it. Some real educational work is needed that will attract young men from banks, department stores, offices and other "genteel" occupations to the really productive pursuits which yield large returns for the intelligent and ambitious. If a boy were shown in his impressionable years a picture outlining the career of two average young men of equal intelligence and ability, one entering a banking office and the other taking up mechanical work, he might be in a better position to judge of future values in these occupations. He would see that the "genteel" occupation seldom offers very much in the way of a career, while the job that looks undesirable because the work is harder may have great possibilities for the lad who works, and studies while he works.

* * *

DIRECTION OF WORK IN PROCESS

Should a piece of work be moved to the right or left after or during the machining operations? This is a question which would be rather unlikely to occur to the average person engaged in mechanical work, and anyone who had not previously considered the matter might easily say that it should be moved to the right, or that it was of no great importance anyway. As a matter of fact, when machining operations are to be done consecutively on adjacent machines, and when the jig or fixture is to be pushed from one man to another during the process, it will be found that the work can be accomplished to better advantage if the fixtures are moved from right to left.

This practice will be found to be of considerable importance in handling very heavy fixtures, such as those used for gas engine cylinders in automobile work, or other heavy work on which several operations are to be performed before removing it from the fixture; the reason is that it is easier to push anything with the right hand than with the left, always assuming that the operator is not left-handed.

Going a step further and assuming that the fixtures used are of small size and can be easily handled, it will be found more convenient for the operator to push the fixture from *left to right* if several spindles on a drilling machine are being used. That is to say, a drill jig which is to be used in several positions under different spindles of a machine can be handled by the operator to better advantage working from left to right than if pushed from right to left.

It will be found advisable to look into the handling of any jig or fixture which is to be used consecutively on several machines, in order to see that the machines are so placed that the fixture can be transferred from one to the other with the least possible exertion by the operator.

* * *

SAFETY AND THE MAN

In a conspicuous place at the American Museum of Safety, New York City, is a safety bulletin on which appears the following: "The best safety device is a *careful man*." This statement has more than ordinary significance to those who are informed as to the conditions existing in many factories and shops. Is it not a fact that, because machines are being adequately guarded and equipped with safety devices, the operators themselves have become more or less indifferent to danger, assuming that the guarding equipment is sufficient to keep them from harm? If this is the case, there is another phase of safety propaganda which shop owners and executives should consider.

Most well regulated shops, factories and offices today, especially in congested districts, have a periodical fire drill which is more effective than issuing written or printed instructions to each individual telling him how to act in case of fire. Written instructions alone are very likely to be forgotten in a sudden emergency, if they have been read, which is doubtful. But if the employe has actually gone through the necessary routine a few times, he will remember what exit to use as well as the other essential points. The best fire escape ever devised will not save a man from burning if he forgets where it is or how to get to it. Likewise the best safety device will not prevent an accident if the operator does not know how to act in relation to the different parts of the machine. Why are not safety lectures with practical instruction given in every shop and factory periodically? The memories of operators of machinery in factories will respond more quickly to practical drill, accompanied by oral instruction, than to any kind of printed rules, and if the dangers are illustrated, as, for instance, by the instructor showing the several ways in which the fingers may be cut off on a circular saw, and the means of avoiding such accidents, the instructions are more likely to make a lasting impression.

Accidents are largely the result of an indifferent mental attitude on the part of the operator. The necessity for safety must exist first in the mind of the individual. Then and then only will it be effective. The mental attitude of the operator is almost as important a factor for safety as the careful guarding of the machine. The latter may be accomplished by state legislation, but the former cannot. That must be an individual matter. Everyone who has machines to operate or who comes in contact with machinery in any way should remember that "the best safety device is a *careful man*."

INFLUENCE OF RIGHT BUYING ON BUSINESS*

BY H. B. TWYFORD†

There is ample scope in the profession of the buyer to solve some of the problems connected with bringing the buyer and the seller together, and to secure for both of them the economic advantages that would be attained by closer cooperation. The improvement of the present conditions depends largely upon the use of more efficient methods of buying. Scientific salesmanship has its limitations. It has failed to meet and cannot meet some of the situations created by unscientific buying. Education in selling has been devoted to schemes for getting business, and this has given highly satisfactory results; but more could be accomplished by treating it as an economic study. This viewpoint must almost wholly govern developments in the art of buying.

To illustrate this point, an instance is given of an unscientific buying transaction which actually occurred. The purchaser was in the market for a large quantity of steel forgings, and on referring to his records found he had a list of eight manufacturers of forgings, to each of whom he sent a request for quotations. From two of these, bids were received; but the remaining six were unable to quote for various reasons. Four made only drop-forgings; one was not equipped for forgings as large as those required; and for another the forgings were too small. The result was that the buyer had only two bids on which to base his order, whereas if he were working at an efficiency of 100 per cent he would have had eight bids. It is not to be expected that this percentage of efficiency can always be attained, but that much better results than 25 per cent can be secured is beyond question. This is not an isolated example for it exists to some extent in every purchasing agent's office.

In the instance related, 75 per cent of the buyer's efforts were fruitless; and the same percentage of manufacturers of forgings who were asked to quote incurred an addition to their selling expenses with no prospect of any business eventuating from the loss of time, trouble and expense to which they were put. Every business house is up against this condition, and it is expected and provided for, but if better methods of purchasing were able to eliminate even half of these non-productive activities of the sellers, an enormous saving would be effected. It is conceivable that many concerns could reply immediately to such an inquiry, stating that they were unable to quote, and the resultant wasted effort and expense would be small; but in this particular instance, the question of making the forgings was in three cases referred to the estimating department, and in one case to the shop superintendent before the firms declined to bid.

Another source of unnecessary expense to manufacturers and wholesale houses, caused entirely by inefficient buying methods, arises in those cases where requests for quotations are worded in such an ambiguous manner that there is some perplexity on the part of the bidders as to what is actually required. Sometimes a size is incorrectly given or the careless specification can be interpreted to cover two entirely distinct articles. This involves requests for additional information by telephone or letter, or sometimes salesmen are sent to make inquiries for the purpose of clearing up uncertain points. This also happens with orders when issued, and it is a fault which is entirely too common.

Any betterment of these conditions would tend to reduce the selling expense and consequently lower the selling price. Thus the buyer would be likely to derive a material benefit, but such a benefit could only be brought about by using more scientific methods. Scientific salesmanship cannot cope with certain phases of unscientific buying. The remedy lies with the buyer, and the economic advantages will not only be secured for his own concern but for all those with whom he does business. If one considers the wide ramifications of business, and the successive buying and selling from the raw material to the finished product, it will be realized that this question of right buying has a broad significance and that its influence on business is universal.

The real salesman is the man who discovers live prospects and sells goods. The real buyer is not the man who merely places orders but the one who discovers live prospects among those concerns who are able to sell him what he wants when he wants it and at the right price. The educational efforts made to improve the conditions of buying have not yet reached the stage or been given sufficient prominence to correct many of the evils that still exist, but much is being accomplished. The art of selling is much more highly developed, probably because it is more spectacular and also because it is the means of getting business. It has been governed too largely, perhaps, by the natural ambition of every salesman to increase his sales and of every manufacturer to see his business grow, with insufficient consideration of the economic aspects of the situation. If education in buying brings about a readjustment of the two functions, the present disproportion between the buying and selling expenses of a concern will be brought into the proper relation to each other. Not that the expenses of buying will be materially increased, but the application of better methods should make an appreciable difference in selling expenses.

What is the remedy? It is absolutely essential to know where to buy to the best advantage; and as already indicated, promiscuous requests to manufacturers for quotations will work to the disadvantage of the purchaser. It is important that every buyer should collect accurate information regarding the available sources from which he can make his purchases; and it is not sufficient for this to be just a list of manufacturers or firms dealing in the particular commodities he may be called upon to buy. By a process of selection and elimination he can make this list accurate, complete and confined to those concerns which are in the best position to supply his requirements; and he can then practically concentrate his entire efforts upon them. This method cannot fail to secure for the buyer the most efficient results, and the business will go to the seller with the minimum amount of wasted effort on the part of competing concerns.

In compiling and tabulating information regarding sources of supply there are several factors to be taken into consideration. Not only must the firms to whom the business is given, and with whom negotiations are conducted, be able to make the goods, but they should also be geographically located so that an unfailing supply is assured. Recent freight embargoes have demonstrated to many concerns the wisdom of distributing their purchases in such a manner as not to be dependent upon one manufacturer or one transportation line. Scientific buying precludes the possibility of failure to obtain delivery of goods at the time required and where required. The serious losses that might ensue if proper precautions were not observed are obvious, and provision must be made for keeping records of the character, reliability and financial responsibility of the concerns dealt with.

The recent industrial activity has demonstrated to many buyers the necessity of maintaining these records and the serious losses that may occur by not keeping them up to date. With many buyers the main question today is not one of price, but of getting the goods at some definite date. Orders are being placed and distributed on geographical considerations only. To those actually engaged in buying, many curious and instructive situations have arisen, in some of which the purchaser was able to show the seller from the information he had on file that he was unable to make delivery in the time he had undertaken. A manufacturer who had been accustomed to taking orders for certain material for shipment in one month, but who kept no proper records, continued soliciting business on the same time basis and accepting additional orders from new customers until his factory was booked with work for six months ahead. Against these conditions the buyer must protect himself.

Another manufacturer is doing business in a succession of "waves." He quotes low prices until he has secured all the work he can handle, and then he promptly quotes ridiculously high prices; but just as soon as he has worked off

* For additional information on the subject of purchasing see "Tool System of Cadillac Motor Car Co." published in MACHINERY for June, 1916.

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the accumulation of orders, he commences to cut prices again. This is a condition against which the buyer must take precautions; otherwise, the loose methods of the manufacturer will probably cause him serious trouble and losses. Scientific buying does materially reduce the cost of selling and this should be one of its chief claims to greater recognition. In addition, it is a measure of safety against loose methods on the part of suppliers and manufacturers, which are likely to cause trouble for the buyer.

* * *

POSITIVE INDICATOR STOPS APPLIED TO LATHE WORK

The following article describes how two very accurate dial indicators were attached to the cross and longitudinal slides of a lathe in such a way as to make it possible to machine work to the highest degree of accuracy without the use of a measuring tool. To understand the operation of this device, reference should be made to Fig. 1, which shows the work—a drill press spindle—in a lathe. A drawing of the spindle is shown in Fig. 3. This shaft is held at its outer end in a specially constructed steadyrest; the other end is grasped by a spring collet in the head of the lathe. The steadyrest is built rigidly and made very accurate. The shaft runs in a split bronze bushing, half of which is screwed into the main body of the steadyrest and the other half into the hinged portion of the steadyrest. The hinged portion is accurately lined up with the lower portion by the latch which is clearly shown in Fig. 1, thus causing the two faces of the bronze bushing to be accurately lined up. It is on the hinged portion of the steadyrest that one of the dial indicators is mounted.

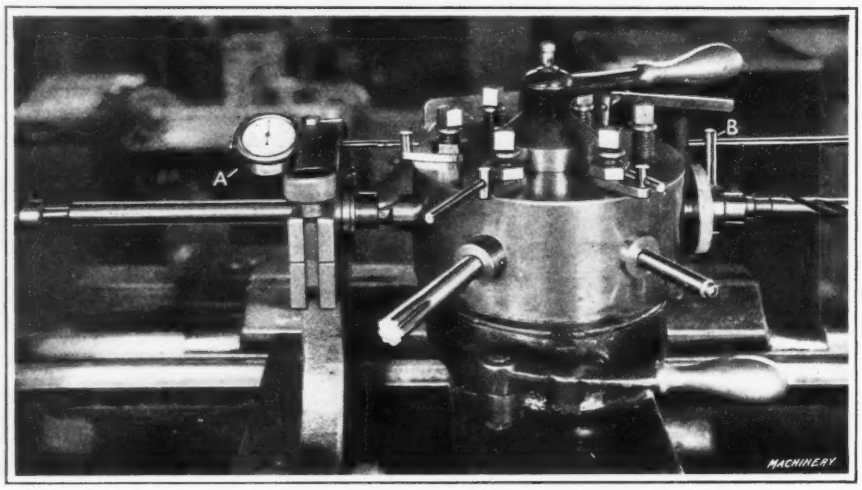

Fig. 1. Lathe equipped with Indicator for gaging Longitudinal Dimensions

In placing the shaft in the steadyrest, the hinged portion is thrown back, the shaft laid in, one end projecting into the spring collet, and the hinged portion brought over and tightened; then a 0.010-inch shim is slipped between the large shoulder on the shaft and the front of the steadyrest bushing. The shim is afterward removed and the spring collet tightened, which takes up the 0.010 inch and draws the shoulder of the shaft snugly against the steadyrest. It is essential that all the shafts be accurately located from some point and this is the point chosen from which to take all longitudinal dimensions.

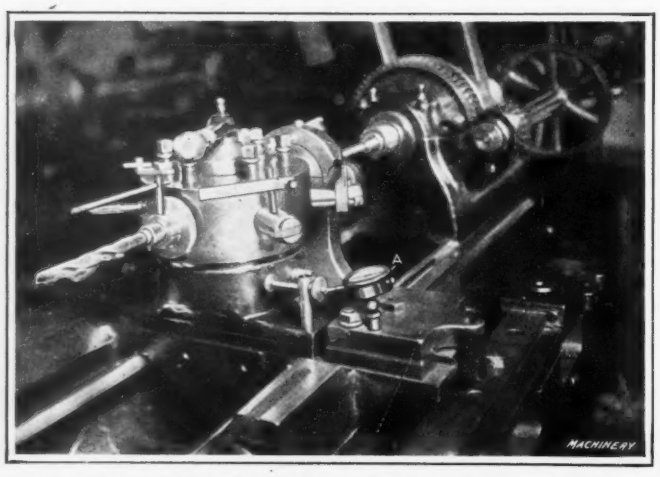

Fig. 2. Lathe equipped with Indicator for gaging Crosswise Dimensions

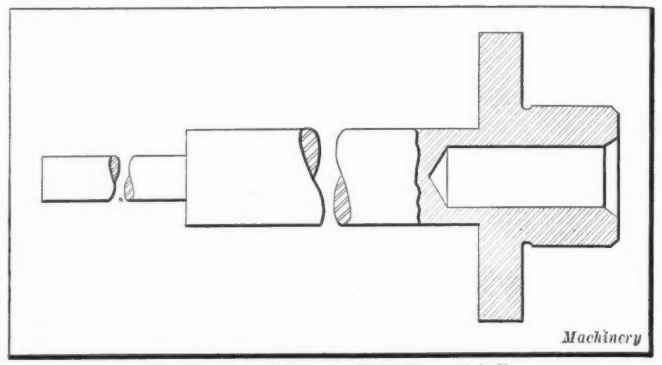

Fig. 3. Detail View of Drill Press Spindle

The indicator *A* in Fig. 1 is actuated by the various fingers or stops which are shown mounted on the turret head, and the operator has previously so adjusted these stops that when the carriage is advanced far enough to cause the hand of the dial indicator to point to zero, the cutting tool has advanced to exactly the correct position, so that the operation is performed without the use of any measuring tools.

The second indicator *A*, Fig. 2, is mounted on a stationary portion of the carriage and its finger protrudes into the path of an adjustable stop which is mounted on the cross-slide of the lathe. The stop on the cross-slide is adjusted in such a manner that when the center line of any one of the tools in the turret exactly coincides with the center line of the spindle of the lathe, the hand of the indicator will point to zero. When such operations as drilling, reaming, centering or countersinking are being performed, the cross-slide is, of course, adjusted so as to cause the indicator to read zero. In such operations as rough- and finish-boring, the cross-slide may be set over so as to leave any specified amount on the diameter of the hole being bored, which will be accurately indicated by the indicator *A*, thus making it unnecessary to caliper or gage the hole being bored.

The operations on the drill press spindle consist in first drilling to the required depth, using the indicator for longitudinal work; second, rough-boring, leaving 0.015 inch on the diameter, and then finish-boring, leaving 0.003 inch for reaming, in this case using the cross-slide indicator; third, reaming, using the cross-slide indicator to centralize the turret; fourth, shaving, leaving the turret on center and gaging longitudinally by the longitudinal indicator (this being the operation illustrated in Fig. 1); fifth, rounding inside edge of countersunk hole, using the cross-slide indicator to show when the full radius is secured; sixth, facing end and chamfering with a combination tool, using the cross-slide indicator to show when the correct amount of chamfer is secured.

The longitudinal stop or finger *B*, Fig. 1, for the drilling position is arranged in a different manner from those in the shaving, boring and reaming positions. This finger is an integral part of the drill-holder; thus the drill, with the holder and finger, may be removed from the machine while another operation is being performed. When it is necessary to machine more of the parts, this drill and the other tools so equipped may be simply slipped into the turret without adjusting the fingers. This is not so with the fingers attached to the turret, as they must be adjusted at every set-up. These attachments are applied to an ordinary engine lathe with a turret toolpost, in use in the factory of W. H. Nichols, Waltham, Mass.

V. B.

THE DETAIL ENGINEER

SIMPLIFIED DESIGN AND A SHOP SYSTEM WHICH RESULTED IN INCREASED PROFITS

BY GEORGE P. PEARCE*

NOT long ago the president of a well established manufacturing company called upon his manager to give a reason for the decrease in the profits of the business which had been noticeable for some time. In taking up the matter with the manager, the president stated that although the management seemed both thorough and systematic and although efficiency methods had been installed throughout the factory, yet the returns on the investment had only been about 3 per cent for the past year. Naturally, the situation was somewhat serious as it is evident that no factory could continue to do business for any length of time with a profit as small as this.

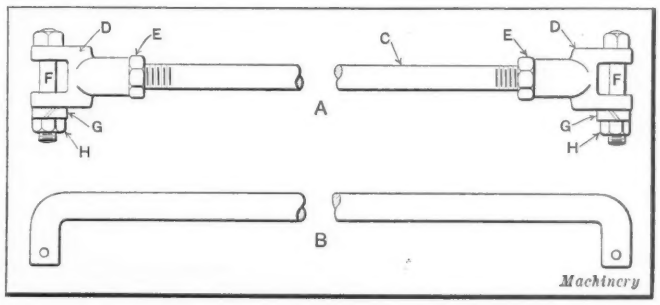

Fig. 1. (A) Old Design of Connecting-rod. (B) Improved Design

In reply to the inquiries, the manager stated that a number of things were responsible for this condition, and further remarked that the company should be satisfied that any dividends at all were forthcoming, as the competition was very strong; and he further argued that if the greatest care had not been exercised to hold the expenditures down as low as possible, there would not have been any profit at all. The manager complained that it was very difficult to get men who would take an interest in their work; and in confirmation of this he stated that twice during the past year he had instituted a general house cleaning, during which he had eliminated practically all the undesirable workmen and replaced them by new men. Even under these conditions, however, he stated that he had found it very nearly impossible to get the right kind of men to stay in the town. The president said that he could not see how it was that some of his competitors had made a profit of 15 per cent in the past year. The manager thought the reason this other firm had been so successful was that it had accumulated an organization which worked together to good advantage so that everything went along smoothly. He stated further that the other firm had been in business ten years to five of the company with which he was connected. However, the president seemed to think that it was the manager's business to see to the cooperation of the various heads of departments and made this statement very plain. The manager finally said that the president would complain if men of this kind were employed because their salaries would be so high that the company could not stand the strain.

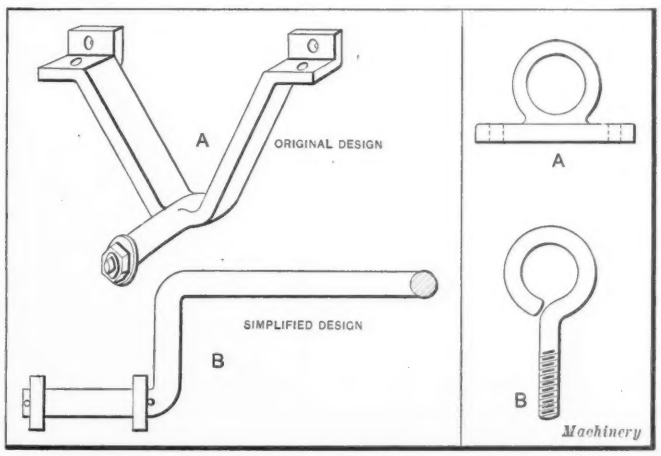

Fig. 2. (A) Old Design of Bracket Forging. (B) Simplified Design substituted by Detail Engineer

Fig. 3. (A) Original Eye Forging. (B) Standard substituted

The president then stated that he believed the methods themselves were at fault, and that although he believed the manager was conscientiously doing his duty, there must be something radically wrong with the methods used. It had been determined at a meeting of the stockholders that there were too many efficiency schemes, geometric decreasing premium plans, task systems, charge plans for the tool-room and many other intricate methods of doing things, which had been largely responsible for the decreased profits of the organization.

A decision had therefore been reached at the meeting to call in a well-known detail engineer and have him look over the situation and endeavor to determine the trouble. The manager at first demurred at the proposed innovation, and stated that he would resign so long as the work which he had done was unsatisfactory, even after he had done his utmost to make a success of the undertaking, but he was finally persuaded to reconsider and remain to see what the effect of the detail engineer's work might be on the organization. After he had consented to this arrangement rather grudgingly, he said that he hoped the detail engineer would be able to devise some system that would cut costs closer than he had been able to; that he knew that the wages could not be reduced another cent without the men going out on strike; that he did not see how it would be possible to make the men work any harder, for they were obliged at present to exert themselves to the utmost in order to make living wages; and finally he didn't see how a stranger could come into an organization and expect to know more about it in a few weeks than men who had been connected with it for years.

The Detail Engineer Appears

About a week after this talk between the president and the manager, a quiet medium sized man appeared at the office and presented a card which simply stated that he was William Steelworth, detail engineer. The president had a talk with him and outlined the situation fully; after which Mr. Steelworth asked, without any comment on the situation, if he might have permission to roam around the plant and make his own observations for a few days, which of course, was immediately granted. After a week had been spent in inspecting the plant in its various departments, Mr. Steelworth once more appeared at the president's office and asked to be placed in full charge of the entire plant with authority to make any changes he desired. Although this was somewhat more than the president had bargained for, he finally concluded that the engineer knew his business and that things could at any rate not be much worse than they were at present; therefore, the desired permission was granted.

Shortly after this, remarkable things begin to happen in the factory. One of the first of these was the removal of the innumerable notices, rules and regulations which had been distributed all over the factory; then a meeting of the men was called by the detail engineer at which they were told that the charge plan of issuing tools would be discontinued and that all tools could thereafter be obtained from the tool-room on checks; he also said that the premium plan and task systems would be abandoned and for a short time the work would be on the day work basis, every one being paid wages which were a little better than the average paid in the town. He stated fur-

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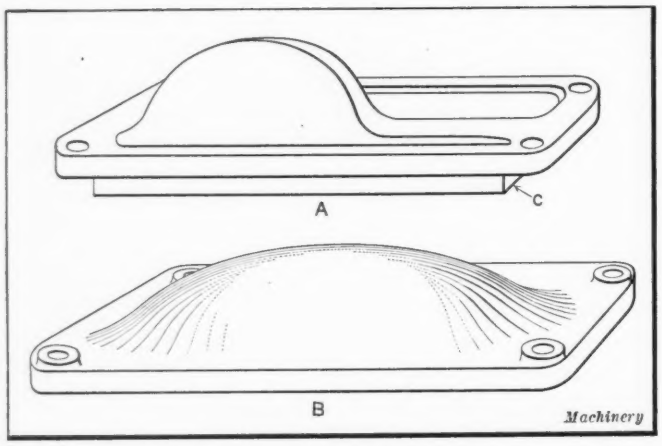

Fig. 4. (A) Gear-case Cover requiring Some Machining. (B) Improved Design finished on Disk Grinder except for Drilled Holes

ther that a little later a simple piece-work plan would be installed that would undoubtedly be satisfactory to all concerned. The new arrangement seemed to please everyone for the reason that by the old system it had been quite difficult to earn on an average as much as the minimum wages in the town.

For several months after this, great activity was apparent in the drafting-room and new models of various lines were developed. Shortly after this, a new piece-rate plan was established, and the men were informed that these rates would be maintained for the next two years at least, but that the right was reserved to readjust them if some newer or quicker way of doing any operation could be developed. He also said that in a short time the men should be able under the new system, to increase their wages from 30 to 40 per cent. It was remarkable to see the way in which the stock and parts were kept moving through the shop shortly after this system had been established, and while there was no particular show of great activity, there seemed to be a determined expression on each man's face that indicated the interest with which he was doing his accomplished task and thinking and planning out every move in advance so as to produce the work to the best advantage.

The Manager Makes a Few Remarks

During all these activities, the manager had been keeping his eyes open and his mouth shut and now felt that a climax must soon arrive. When he checked over the payroll for the current week, he was sure that the time had come without a question. Gathering up the data which he had accumulated, together with the payroll, he hastily entered the president's office without the formality of knocking. In his statements to the president, the manager made it evident that he considered that the firm was on the brink of ruin and that the sooner the detail engineer's practices were stopped the better it would be for the company. He gave as a reason for this belief, the evidence of the payroll, which he stated, showed about 25 per cent more being paid in wages for practically the same number of hours of work, and he was very sure that the men could not do 25 per cent more work or even 10 per cent more, for these matters had been thoroughly tested on many different jobs and the old premium system had been set a small amount ahead of the quitting effort of the man. In addition to this, the manager stated that everything had been changed all over the shop and new designs had been installed, new tools, jigs and fixtures had been made, and as a matter of fact, he was sure that instead of reducing expenses, the detail engineer had systematically increased them until it was at present costing about 30 per cent more to run the shop than it had six months before. He stated as a reason for his bringing up the matter at this time that he thought a 3 per cent dividend was greatly to be preferred to a 27 per cent loss.

In answer to this, the president stated that he had not paid very much attention to the details of what the detail engineer had been doing, but that he knew of the wonderful reputation which he possessed for making a losing job pay dividends, so that he had deemed it best to let him alone to straighten things out as best he might. The manager, however, was fully convinced that a fine mixup had been made of everything and he thought it doubtful whether things would ever be put on a paying basis again. He was also pretty sure that the men would all quit when they were put back on their old schedule as would, of course, be necessary after the detail engineer had finished his work. The president concluded that there might be something in what the manager said, and therefore thought it wise to send for Mr. Steelworth.

The detail engineer did not seem greatly worried over the discoveries of the manager, nor did he appear to mind the apparent losses to which he was subjecting the company by his changes of methods. In defence of his attitude, he stated that it was true that the men were being paid more for the same hours of work, but that the manager was somewhat mistaken in estimating the cost at 30 per cent more than it had been formerly, the actual amount being 36 per cent. He also admitted having changed the design of a number of parts, which therefore required the making of new jigs and fixtures. Going a step or two further, however, he stated that at the present time the material cost of the product had been decreased 22 per cent and the labor cost 45 per cent, or a total decrease in the cost of the product of 67 per cent.

Neither the manager nor the president could quite understand just how the statements of the detail engineer could be reconciled with what they thought they knew themselves about the changes and the extra cost incurred. The detail

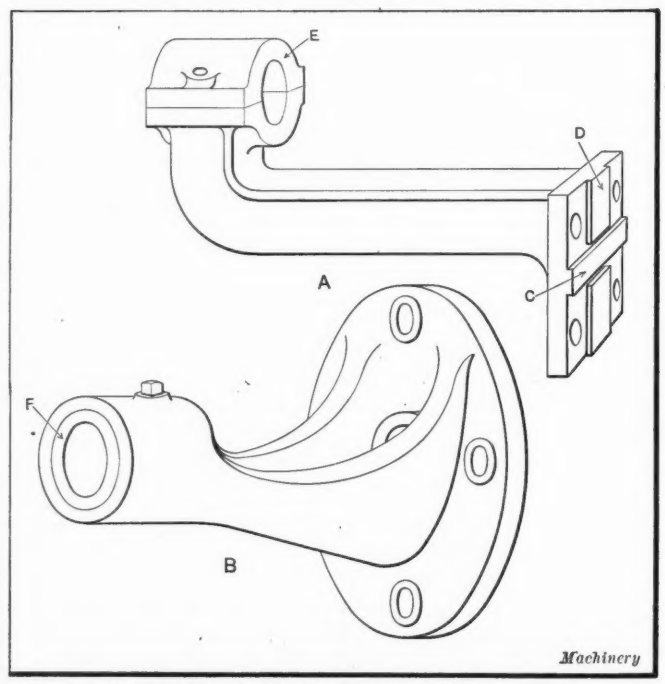

Fig. 5. (A) Original and Expensive Design of Bracket. (B) Improved Design of Much Cheaper Construction

engineer said that it could be very easily explained, and the answer to the question was simply that the output had been increased over 400 per cent. The manager wanted to know what was being done with the machines that were being produced, as they had previously had trouble in selling the smaller quantity which they made and the sales had been decreasing year by year. It seemed that the detail engineer had not overlooked this point, and he had taken a trip to the various agencies and had offered them a 10 per cent extra discount if they would make a year's contract. The result of this had been that they took the extra 10 per cent with avidity which increased the year's demand 250 per cent; it seemed also that orders had been placed with some new firms so that the requirements for the coming year had been brought up to over 500 per cent more than last year. The detail engineer pointed out the fact that after allowing for the extra 10 per cent discount, a handsome dividend would be assured for some time to come.

The manager seemed somewhat doubtful about the matter, but the president of the concern was very much interested and anxious to know what steps had been taken by the detail engineer in order to produce the results which he claimed. Furthermore, he did not see just how it was possible to cut the cost of production by increasing wages, but his inquiry of the detail engineer gave the following data which may make the matter clear.

The Detail Engineer's Report

In the detail engineer's statement of conditions as he found them when he first undertook the work, he cited a number of facts which were unknown to the president of the concern. In the first place, he found that every man in the factory was driven to the limit, and had the feeling that the only way he could hold his job was by making a great display of energy with the result that there was plenty of noise and racket and a great deal of rushing and hustling about. There was no place in the factory for the quiet worker who never made an unnecessary move and he was soon made to feel that he was out of place and either had to make a showing of some kind or get out. The detail engineer seemed to think that considerable credit was due to the men for the work they managed to do under these very trying and adverse conditions, but his idea was that the proper way to judge a man's work is by the amount of it that he turns out and its quality, and that all the activity which was apparent on every side did not necessarily mean industry. In looking over the manufacturer's product to see why such a tremendous effort was required to manufacture such a simple machine, it became apparent that the machines were designed for construction along lines which were unfavorable to quantity production. A few of the instances that he found and improved are noted herewith.

Fig. 1 shows a connecting-rod *A* which was used on one of the machines and is composed of the following parts: one 0.30 carbon steel rod *C*, threaded at both ends; two malleable iron forked ends *D*, threaded, faced and drilled; two lock-nuts *E;* two turned bolts *F;* two lock-washers *G;* two hexagon nuts *H;* making a total of eleven parts altogether. Attention was called to the fact that this rod had very little work to do and that there was no need for adjustment, providing the center to center distances were made commercially accurate. For this reason, the detail engineer entirely eliminated the rod in the new design and in place of it made one up like that shown at *B*. The improved design was made from a simple piece of cold-rolled steel bent over at the ends as shown, and held in place by two cotter-pins. This form required no machine work at all and there were only two holes to drill, so that the saving is very obvious; also the piece performed its function better than the original design because its construction makes it impossible to loosen as the old one did occasionally in the threaded portion.

The bracket forging on another machine, shown at *A* in Fig. 2, was made to carry the idle reversing gear. It will be noticed that this was a very bad forging to make and required a number of special dies and equipment, even in its rough state; and after it was made it was expensive to machine. In order to reduce the cost of construction on this work, a few changes were made in the design of the machine which permitted both sides of the frame to be used as supporting members so that the final result was that the bracket could be made up from cold-rolled steel as shown at *B* in Fig. 2. It can readily be seen that this is a very inexpensive piece to make, requiring only a bending operation and the drilling of two holes, as indicated. It has since proved to be of ample strength for the work for which it was designed.

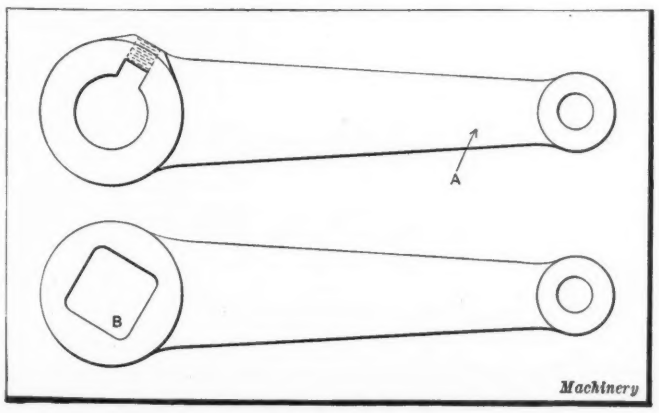

Fig. 6. (A) Original Design of Rocker Lever. (B) Improved Design requiring Less Machining

A number of other changes were made in the forgings and no point was considered too small to be taken up by the detail engineer. The little eye-forging which held a small counterweight on one of the machines and which is shown at *A* in Fig. 3, was replaced by the standard formed wire eye shown at *B*. It would not have been possible to do this had it not been for the fact that in redesigning the machine on which this piece was used, suitable changes were made to permit it. In the original design, the piece was bolted onto a box section, while in the new design it was simply screwed into place. The difference in cost was such that fifty pieces of the new design cost about the same as one of the old style pieces.

Forgings were not the only parts that were changed, as some of the castings were redesigned to good advantage also. Referring to Fig. 4, which shows a cover *A* for the gears on one of the machines, the improved design *B* was made larger so that the clearance for the large gear was ample and it was unnecessary to machine the lip *C* on the under side, as the piece could be located by cap-screws closely enough for all practical purposes, as indicated. In the new design the machining was done on a disk grinder in about thirty seconds, and both covers are alike so that there is no right and left hand as formerly. Either end can be placed at the front with equally good results.

Another instance of an improvement is in the bracket *A*, Fig. 5, which formerly was used to locate and hold the extension shaft for the pinion gear drive on one of the machines. As originally made, this had solid cross keys *C* and *D* on the foot to locate it accurately, which made a very expensive machining job requiring a number of accurately gaged operations together with careful inspection, and even with these precautions some of the machines were being shipped with noisy gears, due to imperfect alignment. In changing this piece over, a few alterations were made in the frame of the machine and a hole was bored and faced so that a casting machined like the one shown at *B* could be bolted on. This casting is simply drilled first and then faced and flanged on a mandrel, both these operations being cheaply and rapidly done.

At this point in the detail engineer's report, the president wished to know how a certain key was placed in the pinion which was mounted on this bracket. In the original design the pinion had been placed on the shaft and keyed in position, after which the cap *E* was placed on the bearing; but in the new design the same result was accomplished by leaving out the bronze bushing *F* and pushing the pinion into position through the hole and holding it there while the shaft was pushed in from the front, a Woodruff key being in the shaft. As the key has less projection than the thickness of the bushing wall, no difficulty was experienced in slipping it through the hole, after which it could be driven in place and the bushing put in and fastened by the set-screw shown.

Another important change which was instituted is shown in Fig. 6. There were four of these spring tension rocking arms *A* on one of the machines, and these were bored, keywayed and set-screwed as indicated. A piece of 1-inch square stock was used in place of the 1-inch diameter shaft, and the rocker arms were cast with a square cored hole in them as indicated at *B*. The hubs of the rocker arm were made ¾ inch longer than formerly so that the hubs of the four rocker arms just about filled the space between the bearings on the machine; and it was thus unnecessary to put in any set-screws. In providing for the bearings themselves, the corners of the square shafts were ground slightly

so that the shafts could be run through the bearing and rocker arm, and a couple of washers with square holes in them were slipped onto the projecting end, after which two cotter-pins were put through the shaft.

Many other changes were made by the detail engineer, each of which tended to eliminate unnecessary labor and simplify the general design of the machine. A great saving was possible through the care used in this redesigning, but the greatest improvement was obtained through the energetic and loyal organization of the men which was gained by eliminating the complicated systems and getting rid of the idea that every man must be on the jump every minute of the day. The new piece rates were so proportioned that good wages could be made, so that at present the men are fairly well contented and happy, with the result that everything is running smoothly and with over 400 per cent greater output, all of which is sold for the next eighteen months in advance.

About this time the general manager came back into the office and stated that things had been found in the factory as represented by the detail engineer. He furthermore remarked that he was as yet unable to understand how it was possible to have produced results such as those indicated, which he confessed seemed more or less of a mystery to him, but he was perfectly willing to give full credit to the detail engineer for the results which had been accomplished.

In talking over the matter, the detail engineer brought out a few points which are worthy of mention. He stated that about three-fourths of the credit was due to the men in the shops and drafting-room, and that their willingness made all the difference between a successful organization and failure. He laid considerable stress upon the fact that the men should be treated as partners in a commercial enterprise, and not as mere wage earners; and it was his belief that the devising and installing of complete task systems and other methods which are based upon the old and erroneous idea of driving men, were great mistakes, and that it had been found to be much easier to lead men than to drive them. After this explanation had been given, Mr. Steelworth said that he reached the conclusion that there was no further need of his services at that factory, as everything was now running along smoothly, and he expressed the hope that it would continue to do so. A number of lessons can be learned from these experiences, and while all the points may not be applicable to every variety of mechanical work, there are few manufacturing plants in which great savings cannot be accomplished by careful attention to details, both in the factory under working conditions and in the design of machines themselves. Furthermore, it should be remembered that in order to obtain the greatest efficiency in any manufacturing establishment, not only the mechanical features but the human factors must be carefully considered. Contented workmen are prominent factors in producing work of good quality with minimum expenditure.

* * *

According to G. F. Eberhard, in *The Metal Industry*, the first watches were made in the year 1500, in Nuremberg, Germany. They were made completely of iron, even the dials. Brass was substituted in 1530, and in 1550 watches began to come into vogue. In 1570, odd-shaped watches, hexagon and octagon shape, began to be fashioned. It was not until 1587 that the watch industry began in Switzerland. The fuzee chain was invented by a Swiss by the name of Gruet in 1590. Up to this time a catgut cord was used. Watch crystals of glass were first made in 1615. Enameled dials were first made in 1635. The balance spring (known as the hair spring) was first made in 1676. It is said that this was made from hog bristles, and that is how the name "hair spring" originated. The minute-hand device was first made in 1687, with its hour and minute wheels and cannon pinion which carries the minute hand. The first keyless watches were made in 1700. The compensating balance was invented in 1749. The duplex escapement was first made in 1750. The lever escapement was invented in the year 1776. Second hands were first used in 1780. Thin watches were first made in 1776. All important inventions for making watches were made in Europe.

NOTES ON TOOLMAKING

BY WILLIAM YOUNG*

There are a number of processes of sufficient interest to be especially noted in connection with accurate tool work, although they are incidental to the regular occupation of toolmaking and for this reason have been little touched upon in books or articles on toolmaking methods. In the following notes on lapping, filing and die work, there are many suggestions that may be of value to those who have not had much experience in this class of work.

Lapping

It is quite important in preparing to lap a piece of work, to select an abrasive that will produce the work within a minimum amount of time and at the same time leave a finish which will be of the required degree of fineness. It may be stated that it is inadvisable to use coarse emery when a polished surface is desired, and as a matter of fact coarse emery should not be used even for the preliminary cutting down unless a considerable amount of surface is to be removed, because it is likely to leave scratches so deep that they cannot be removed by the finer abrasive used subsequently. The abrasive used for this purpose can be mixed with oil or its equivalent, but gasoline is considered the best lubricant for operations of this kind because it evaporates and permits the abrasive to take hold and cut faster than if plain oil were used. In lapping out a hole in rough work, the cheapest method is to use a piece of split wood with emery cloth inserted and twisted around until it nearly fits the hole. In bronze or brass work a mixture of crocus and Vienna lime can be used to advantage; and unslacked Vienna lime, freshly crushed, can be used with a hard wood or lead lap and will continue to cut for a long while, but is very slow in its action.

It is well to remember that there are distinct substances and grades for different kinds of work and that the material used in lapping is largely governed by the kind of metal to be lapped and the speed of the operation. One of the best abrasives to use for small holes is diamond dust which has been charged into a copper, brass or bessemer rod, but caution must be used not to crowd this style of lap because it will "strip" easily. It must be remembered that diamond dust is expensive and should therefore be used sparingly. If a particularly high finish is desired on a piece of work, a piece of boxwood charged with diamond dust will give the finest results. No. 1 diamond dust is the best grade.

Lapping Cylindrical Work

For cylindrical work a copper or cast-iron lap is commonly used. The lap should always be long enough to extend entirely through the hole with a generous margin and should be made a running fit so as to lap the highest parts. A reciprocating motion should always be imparted to the lap in order to avoid lumping the emery and scratching or cutting grooves in the work. Care must also be taken to keep the laps parallel to the work in order to avoid having an irregular hole or one which is more or less bell-mouthed. In plug and ring gage work, care must be taken to cool the ring gage thoroughly in benzine and clean it carefully before testing the plug. Whenever it is possible to do so, a shoulder should be left around the end surface of a hole so that if made slightly bell-mouthed, the error can be easily corrected by grinding off the shoulder.

Lapping Flat Work

In lapping parallel work or other work of a similar kind, a cast-iron plate will be found the best. A steel plate should not be used. A plate having scored grooves is the best for flat surfaces and will give more satisfactory results than a plain surface plate. On work of this kind it is well to use a straightedge from time to time in order to note the progress of the work, and in this connection it should be remembered that no matter whether the work is cylindrical or flat, it should never be lapped continuously in one place

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but should be kept moving about, and the pressure should be as nearly uniform as possible in order to secure the best results. When the work is of such a form that it cannot be reached with an emery wheel, a copper or bessemer rod can be formed to the shape desired, charged with emery, and used as a lap to finish the surface. An important point in connection with lapping is to see that the lap is thoroughly clean before being used and that it is cleaned after use.

Notes on Filing

There are a few points of interest in connection with filing, some of which will undoubtedly be familiar to the majority of toolmakers. It is well to heat the tang of the file and burn it into a handle rather than to drive it in. It will hold its position much better set in this way and there is little possibility of splitting the handle. It is fully as important to select the proper grade and shape of file for a piece of work as it is to file it properly after the file has been selected. A good toolmaker carries his file straight across the work without rocking and is careful to see that it is kept clean and free from filings and chips. A file that is filled with dirt and chips cannot be expected to cut rapidly nor produce good work.

In producing a nice finish on a piece of work, the file may be rubbed with chalk, or oil may be applied to produce a smoother finish than if filed dry. On certain kinds of work a file that has been in use for some time may be desirable, but never one that has been abused. If a file has been glazed it is practically ruined and will burnish or harden the material being filed without having much cutting effect. A point worth remembering in connection with filing is that the file may be charged with emery and used for stoning a tool in case of necessity. Finally after the files have been used up so that there is no more cutting action left, the temper can be drawn and they can be ground so that they will make excellent parallels.

Notes on Punch and Die Making

There are a number of points of interest in connection with punch and die making. In making up a set of punches and dies for any particular job, one of the first things to be considered is the material from which the work is to be produced. When blanking dies are to be made for thin metals, the punches must fit tightly, while the clearance should be proportionately larger when the section to be punched is thicker. An allowance should always be made of at least the thickness of the stock to be blanked between the nearest edge of the blank and the cut, this allowance being necessary in order to support the stock. In laying out work, an economy of stock can sometimes be effected by laying the blanks out at an angle, and it is always well to figure on using the nearest width of material in stock when laying out the dies. The kind of steel that should be used in making the punches and dies varies according to the work to be done and the kind of metal to be punched. The hardening and tempering operations should be determined by the quality of the metal to be worked.

Templets

In making a templet, it is a good plan to solder a rod to it so as to prevent the wrong side being inserted through the bottom of the die. When making a pair of templets, the greatest care should be exercised to make them as accurate as the punch and die to be made, as the templets are used as masters from which to form the punch and die. Pilots and piercing holes should be located by using the templet.

General Remarks

In connection with punches it is well to note that when shearing punches in the die, oil should be used and the work should be done a little at a time. When they are to be tempered they should be drawn from the back or shank, and when piercing punches are drawn, care should be taken to draw them evenly throughout their entire length. Tension buttons can be used in the gage plate or stripper when the stock to be cut varies in width. Too much clearance on a die is unnecessary and undesirable, as the greater the clearance beyond a certain point, the shorter the life of the die will be, as it will require more frequent regrinding. In order to provide a surface on which to work when laying out a blank or sample on brass, the material can be sprinkled over with cast-iron or steel chips and then rubbed with vitriol to give a good finish on which the scriber lines or other markings can be distinctly seen.

In laying out the dies themselves, they can be blued over a flame to permit the marking to show more distinctly. It is important that all pilots and the blanking points should be made to size so that the article which has been blanked will be perfectly accurate; hardened steel bushings should always be placed in the stripper plate when small piercings are required. When planing up the steel pieces from which the parts are to be made, sufficient stock should always be removed to get below the scale, as this reduces the likelihood of trouble in hardening. After the die is hardened it should be ground all over and the dowel pin holes lapped. The stripper is then laid on the die and the dowel pin holes are transferred. The dowel pins should be hardened and ground to a tight fit in the stripper and a push fit in the die. The screw holes are transferred through to the stripper and the stripper plate is removed. The die is now swung upon the faceplate of a lathe and one of the piercing holes indicated, after which the stripper is screwed on and centered and a hole smaller than the piercing hole is drilled. This hole is then bored to the outside diameter of the bushing and the stripper is once more removed. This procedure is repeated for the various piercing holes. The bushings for the stripper should be made after the stripper bushing holes are bored and the blanking punch hole is filed out. The bushings should be left about 0.005 inch larger on the outside and about 0.002 inch smaller on the inside than required. They should be hardened and drawn and the holes should be lapped to a close fit on the piercing punch; then they should be put on an arbor and the outside ground to a driving fit in the stripper holes.

An important point in die work is the file finishing of the die, as unless particular attention is paid to seeing that the work is filed to a polish before it is hardened, there is likely to be subsequent trouble due to the work becoming stuck. In order to give good results, the die must be absolutely free from any ridged or irregular surface; the turret angle or arm should be the same and the punch should always be made long enough to pass entirely through the die. Any piercing holes which are to be bored should always be formed in the lathe. After a die has been completed it should be ground, together with its points, before it is tried out, yet it should never be allowed to lie around several days when it is glass-hard, but should be drawn to the proper temper as soon as possible.

A number of the points which are given herewith are not new, and some of those mentioned may seem obvious to the more advanced readers. However, these readers must remember that in their own experience there must have been a time at which information of this kind might have proved of considerable service. Therefore those to whom the material is not of great interest can pass it on to those less fortunate ones to whom the writer hopes it will be of service.

* * *

A comparatively new business is the repairing of motor cars and motor trucks in shops specially equipped with machinery for the work and having a corps of expert workmen thoroughly familiar with the intricacies of the various makes of cars. These establishments can give service incomparably superior to the ordinary garage, as they have machine tools that enable them to make repair parts quickly when not in stock. Not all the work is of an emergency nature, and in a large shop, overhauling from the ground up can be done economically by switching the men to hurry-up jobs as required. In some places manufacturing on a small scale enables the equipment to be profitably employed in slack time.

ACCELERATING FORCE OF RECIPROCATING PARTS*

DIAGRAM FOR DETERMINING INERTIA FORCE FOR VARIOUS PISTON POSITIONS—ERROR DUE TO USE OF CHART

BY HUBERT L. WATSON†

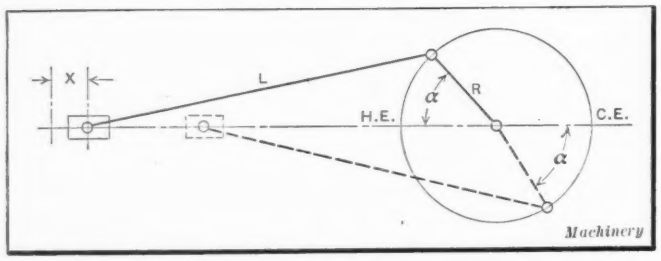

Fig. 1. Diagram illustrating Quantities in Formulas

CERTAIN calculations in the design of parts of a reciprocating engine, such as the flywheel, require a knowledge of the accelerating force or inertia of the reciprocating parts. The accurate determination of a diagram which will show the effect of this inertia is a tedious mathematical process. An expression by which this force may be obtained for any position of the piston is, for the forward stroke:

$$P_1 = -\frac{WV^2}{gR}\left(\cos\alpha + \frac{R}{L}\cos 2\alpha\right) \qquad (1)$$

For the return stroke, the value of this force is:

$$P_2 = +\frac{WV^2}{gR}\left(\cos\alpha - \frac{R}{L}\cos 2\alpha\right) \qquad (2)$$

where W = total weight of reciprocating parts, usually considered as combined weight of piston, piston rod, wrist-pin, and from 45 to 55 per cent of connecting-rod weight;

V = velocity of crankpin in feet per second;

R = radius of crankpin circle in feet;

g = acceleration due to gravity, or 32.2 feet per second per second;

L = length of connecting-rod in feet;

α = crank angle, measured from head-end dead center on outward stroke, and from crank-end dead center on return stroke;

P_1 = the accelerating force during the forward stroke;

P_2 = the accelerating force during the return stroke.

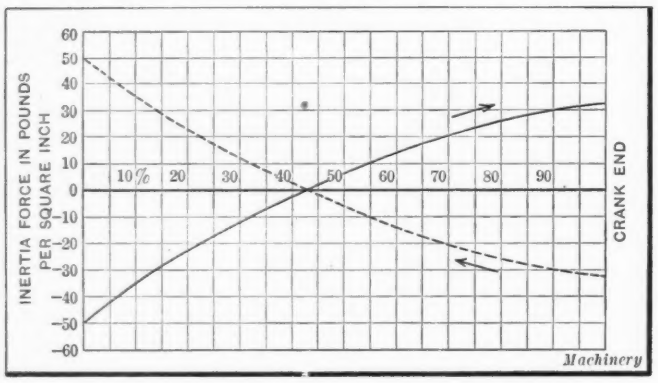

Fig. 2. Diagram showing Inertia Force in Pounds per Square Inch for Various Piston Positions

The derivation of these expressions may be found in numerous design books, such as Levin's "Modern Gas Engine and Gas Producer," page 472; Güldner's (Diederichs') "Internal Combustion Engine," page 156; and in a slightly different form in Unwin's "Elements of Machine Design," Part II, page 68.

It is evident that at the beginning of the stroke the weights of the parts retard the motion, while at the end of the stroke they aid the motion. If it is desired to determine the inertia force at the head-end position, α becomes 0 degrees and cos $\alpha = 1$. Also cos $2\alpha = 1$, and Equation (1), simplified, is:

$$P_1 = -\frac{WV^2}{gR}\left(1 + \frac{R}{L}\right) \qquad (3)$$

At the crank-end position, $\alpha = 180$ degrees. Therefore, cos $\alpha = -1$ and cos $2\alpha = +1$.

$$P_2 = +\frac{WV^2}{gR}\left(1 - \frac{R}{L}\right) \qquad (4)$$

For intermediate positions it will be found necessary to use Equations (1) and (2).

VALUES USED IN PLOTTING DIAGRAM SHOWN IN FIG. 2

Crank Angle, Degrees	Stroke, Inches	Stroke, Per Cent	Inertia Force, Pounds
0	0.00	0.0	50.6
15	0.44	1.7	47.9
30	1.78	6.8	40.1
45	3.89	14.9	28.6
60	6.90	26.5	15.2
75	11.15	42.9	1.7
90	14.61	56.2	—10.1
105	17.88	68.8	—19.3
120	19.90	76.5	—25.3
135	22.27	85.7	—28.6
150	24.63	94.8	—30.0
165	25.79	99.1	—30.3
180	26.00	100.0	—30.4

Machinery

For purposes of comparison it is customary to use $\frac{W}{A}$ or the weight of the reciprocating parts per square inch of piston face, where A = the area of the piston face in square inches. Thus the inertia force will be found in pounds per square inch of piston face. This is convenient, for the mean effective pressure and other pressures are so expressed. At the point where the velocity of the moving parts is changing from accelerating to retarding, the inertia force will be zero. This occurs when the connecting-rod and the crank are at an angle of 90 degrees to each other, or when tan $\alpha = \frac{L}{R}$. The position of the wrist-pin, or the amount of travel from its head-end position, corresponding to any given crank angle, may be determined from the expression:

$$X = R\left(1 - \cos\alpha + \frac{R}{2L}\sin^2\alpha\right) \qquad (5)$$

Let us take an 18- by 26-inch engine running at 200 revolutions per minute, where the ratio of $\frac{R}{L} = \frac{1}{4}$, and the weight of the reciprocating parts is 700 pounds.

The area of the piston face will be:

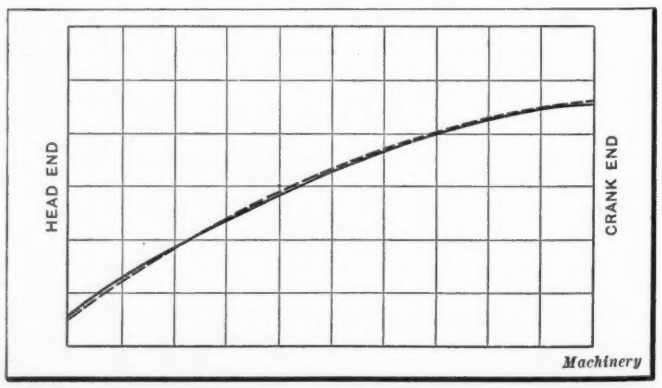

Fig. 3. Diagram showing Difference in Results obtained mathematically (Fig. 2) and by Use of Chart (Fig. 4)

* For additional information on this subject published in MACHINERY, see "Inertia of Reciprocating Parts," November, 1913; "Light Weight Reciprocating Parts for Motors," July, 1913; and "The Inertia of the Reciprocating Parts of a Steam Engine," September, 1900.

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$$A = \frac{\pi D^2}{4} = \frac{\pi \times 18^2}{4} = 254.5 \text{ square inches.}$$

$$\frac{W}{A} = 2.75 \text{ pounds per square inch.}$$

The crankpin velocity is $2\pi RN = \frac{2\pi \times 13 \times 200}{12 \times 60} = 22.68$ feet per second.

Calculating the inertia force for different crank angles, the values are obtained which are shown in the table. Then by plotting the inertia force upon the piston stroke as a base line, we obtain the full line curve in Fig. 2. During the return stroke the values are numerically the same except in the sign, and hence may be readily drawn, as shown by the broken line. The foregoing has involved lengthy and monotonous calculations, which has led the writer to express this inertia force by a graphic chart, Fig. 4, instead of an equation, saving greatly in time and also giving much less opportunity for error. The best explanation of the use of the chart is, possibly, to follow out upon it the problem which has already been solved above. It is necessary to know the following: the weight of the reciprocating parts per square inch of piston face, the length of the stroke, the revolutions per minute and the ratio $\frac{R}{L}$. In the diagram *D*, Fig. 4, note the point on the lower horizontal line representing a 26-inch stroke, pass vertically upward to the oblique line of 200 R. P. M., and immediately to the right will be found the velocity of the crankpin in feet per second, which is 22.6. Similarly, from the diagram *E*, we find that with a ratio of $\frac{R}{L}$ the point where the inertia force is zero is at 44 per cent of the stroke from the head-end dead-center position.

Now in section *A* of the chart proper, upon the ordinate corresponding to $\frac{W}{A} = 2.75$ pounds, move upward to the oblique line of the stroke of 26 inches, in this case interpolated between the 24- and 28-inch lines. From this point move horizontally to the left until intersecting the oblique line in section *B* representing a crankpin velocity of 22.6 feet per second, and then vertically downward into section *C*. Here there are two sets of oblique lines corresponding to the various values of $\frac{R}{L}$, the upper set being for the crank-end position, and the lower set for the head-end position. Thus the intersection of the vertical line with the oblique line of $\frac{R}{L} = \frac{1}{4}$ in the upper set, gives us on the scale to the right, 30.8 pounds per square inch of piston face, as the inertia force at the crank-end position. Following on down to the intersection of the vertical line with the proper line in the lower set, we find the inertia force at the head-end position to be 51 pounds per square inch.

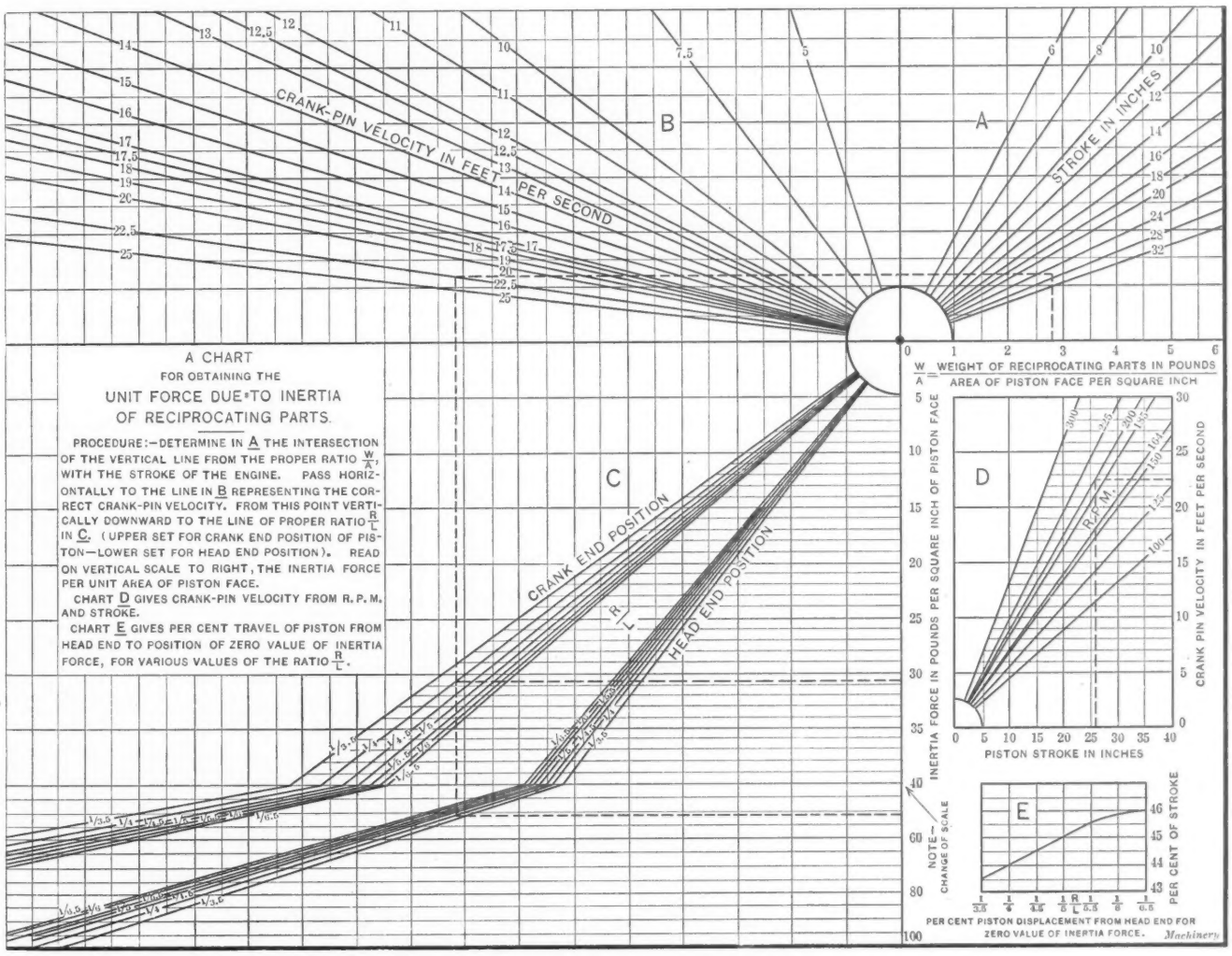
A CHART
FOR OBTAINING THE
UNIT FORCE DUE TO INERTIA
OF RECIPROCATING PARTS.
PROCEDURE:—DETERMINE IN A THE INTERSECTION OF THE VERTICAL LINE FROM THE PROPER RATIO W/A, WITH THE STROKE OF THE ENGINE. PASS HORIZONTALLY TO THE LINE IN B REPRESENTING THE CORRECT CRANK-PIN VELOCITY. FROM THIS POINT VERTICALLY DOWNWARD TO THE LINE OF PROPER RATIO R/L IN C. (UPPER SET FOR CRANK END POSITION OF PISTON—LOWER SET FOR HEAD END POSITION). READ ON VERTICAL SCALE TO RIGHT, THE INERTIA FORCE PER UNIT AREA OF PISTON FACE.
CHART D GIVES CRANK-PIN VELOCITY FROM R. P. M. AND STROKE.
CHART E GIVES PER CENT OF TRAVEL OF PISTON FROM HEAD END TO POSITION OF ZERO VALUE OF INERTIA FORCE, FOR VARIOUS VALUES OF THE RATIO R/L.
CRANK-PIN VELOCITY IN FEET PER SECOND
STROKE IN INCHES
A
B
C
D
E
CRANK END POSITION
HEAD END POSITION
R/L
W/A = WEIGHT OF RECIPROCATING PARTS IN POUNDS / AREA OF PISTON FACE PER SQUARE INCH
INERTIA FORCE IN POUNDS PER SQUARE INCH OF PISTON FACE
CRANK PIN VELOCITY IN FEET PER SECOND
R.P.M.
PISTON STROKE IN INCHES
NOTE—CHANGE OF SCALE
PER CENT OF STROKE
PER CENT PISTON DISPLACEMENT FROM HEAD END FOR ZERO VALUE OF INERTIA FORCE.
Machinery

Fig. 4. Chart for Use in obtaining Unit Force due to Inertia of Reciprocating Parts of an Engine

We have thus quickly determined three points through which the inertia curve will pass. If an arc of a circle be drawn through these points we shall have a curve which very closely approximates the true inertia curve. In Fig. 3 the inertia curve has been replotted, and superimposed on it is the arc of a circle drawn through the points as determined by the diagram, showing the small error introduced by the use of the chart and a compass instead of the more laborious, though, of course, more accurate mathematical solution. If the value of $\frac{W}{A}$ is greater than the maximum shown on the chart, divide the actual value by some number, say 2, proceed as usual, and then multiply the results obtained by the same number, for the inertia is in direct proportion to the weight of the reciprocating parts.

Electric Spot Welding

By Douglas T. Hamilton*

THE resistance method of electric welding is divided into many processes, among which might be mentioned butt, spot, point, ridge, button, seam, etc. In all cases the principle is the same, being based on the resistance offered by the metals being welded to the flow of a low-voltage current. Electric spot-welding refers to the practice employed in forcing sheet metals together by means of copper electrodes and heating the metal through the same medium. There is a limit to the thickness of sheet metal that can be satisfactorily spot-welded. First, the copper rods used for the electrodes will only carry a certain amount of current without excessive heating, and when the current required to accomplish the weld exceeds the capacity of the electrodes, the latter will soften and wear away rapidly. Second, to produce a satisfactory spot-weld it is necessary to have the two pieces of sheet metal touch each other at the point where the weld is to be made. When the pressure required to bring the opposing sheets of metal into contact exceeds the compressive strength of the electrodes, the ordinary spot-welding machine cannot be used. For work of this kind other processes, which are given different names because of the variations in application, are used. One method is to enclose the copper electrodes in hardened steel bushings. The bushings and heating electrodes are operated by separate mechanisms, and to effect the weld the bushings are first operated to bring the sheets into contact, after which the current is turned on and the weld made.

Difference between Butt- and Spot-welding

Electric spot-welding differs from electric butt-welding in that the parts being welded do not necessarily need to be of the same cross-sectional area, and the parts can be welded at one point or at a series of points by forming contact points of the required area upon the faces of the upper and lower electrodes. In the butt-welding machine, the work is held in clamping jaws of varying shapes to suit the work, which are made from copper and serve as electrodes. In the spot-welding machine, round rods of copper are used for the electrodes, and as they are presented in a vertical plane with their contacting points opposing each other, they localize the current at the point where the weld is to be made. As is the case with butt-welding, a large volume of current at low voltage is made to pass through the electrodes, and when two pieces of sheet metal are placed between these points, and the current turned on, the metal instantly becomes hot at the point where the copper electrodes touch it. The hotter the metal becomes, the greater the resistance. The sheet metal between the electrodes is therefore brought to a welding temperature, and a slight pressure of a lever forces the molten metal together and forms a perfect weld at the point of application of pressure.

Electric Spot-welding Machine

An electric spot-welding machine consists essentially of a transformer for reducing the current from high to low voltage, a secondary circuit for conducting the current from the transformer to the welding electrodes, and the welding electrodes or copper contact points for localizing the current and applying the pressure. The constructional features of the various spot-welding machines, of course, differ to a considerable extent, depending upon the kind of work for which the machine is designed. However, the principle upon which these machines are constructed is the same. Fig. 1 shows a common type of spot-welding machine; it will be noticed that the main body of the machine is of the hollow column type to which an overhanging top arm is cast. Working in this arm is a slide which can be operated either by a toggle lever or foot-treadle, as desired. Fastened to the column is a lower arm or holder which carries the lower electrode. Connecting the electrode and the transformer is a series of laminated copper strips. These are attached to the electrode holders by bolts, and the upper laminated strips are so constructed as to permit of movement of the slide. The transformer proper is so constructed that the amount of current passing through the winding, and, likewise, the amount induced in the secondary circuit can be varied. On the column of the machine will be noticed two pointers, one working on the segment of a dial having two positions, "low" and "high," and the other covering a segment numbered from 1 to 5.

In setting a spot-welding machine, the upper regulator pointer should first be set to 1, and the lower regulator pointer to the left marked "low." The work is then placed between the copper electrodes, and these are brought down in contact with it; this forces the stock together and automatically turns on the current. If the stock does not heat rapidly enough, the upper regulator pointer is turned to 2, and this process continued until the pointer reaches 5. If there is still insufficient current to heat the work quickly enough, the upper regulator is turned back to 1 and the lower pointer placed at "high."

For information on electric welding previously published in MACHINERY, see "Welding High-speed Steel Blocks to Tool Steel Shanks," July, 1916, and articles there referred to.

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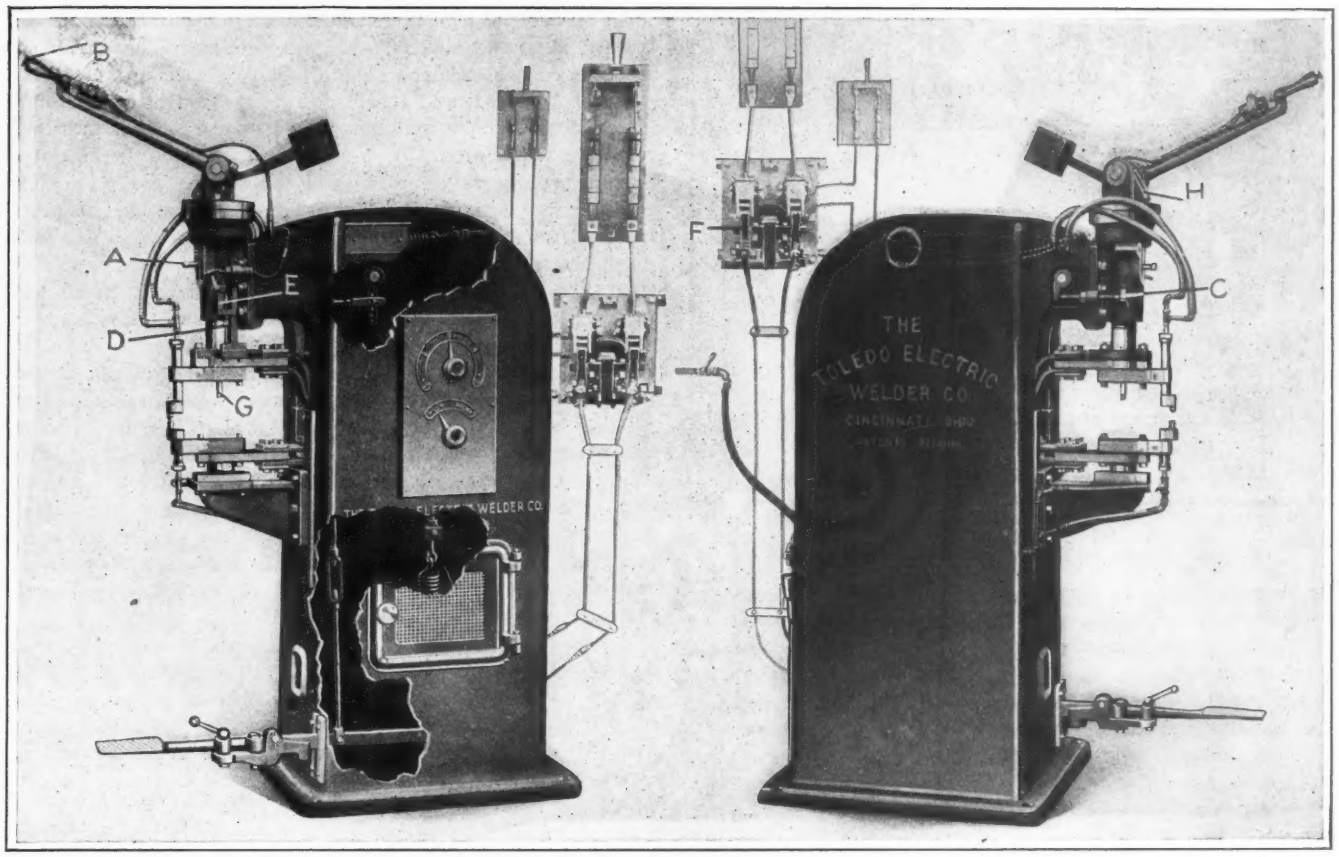


Fig. 1. Common Type of Electric Spot-welding Machine sectioned in Certain Places to show Constructional Features

The same procedure is then followed by moving the upper pointer from 1 to 5 until the proper temperature is obtained. The electrodes should be adjusted with two pieces of stock between them so that the toggle joint in the head of the machine stops just forward of the center in order to give the greatest amount of pressure on the stock.

In this particular machine the switch can be operated either automatically or by hand for turning on and off the current. When welding thick buckled stock, it is difficult to get a satisfactory weld by using the automatic switch, because of the variation in pressure required to force the opposing faces of the sheets together. When the stock is in a buckled condition, pin *A* is placed in the right-hand slot, which disconnects the automatic switch. To operate the machine, the lever or foot-treadle is moved as far as possible to bring the material into contact. The button *B* or control switch in the handle is then depressed and this turns on the current.

In using an electric spot-welding machine continuously, the copper electrodes become heated, and in order to increase their life a water cooling system is provided. The holders which carry the welding electrodes proper are made hollow, and through these a tube passes, allowing water to circulate close to the welding contact points. Each pair of electrodes is provided with a water supply and return pipe, and this is connected to the sewer.

Operation of an Electric Spot-welding Machine

The operation of an electric spot-welding machine differs from that of a butt-welding machine in that as a rule there is no clamping of the work necessary on the spot-welder. The two sheets to be joined are simply held in the hands in the correct position and in the proper location in relation to the copper electrode points. When this is done, the operator simply pulls down the lever or operates the foot-treadle. When the automatic switch is closed, this allows the current to pass through the contact points, and the material placed between them immediately becomes heated. When the proper temperature has been obtained, pressure is applied to effect a junction between the two sheets being welded. In order to get the correct pressure between the sheets, the electrodes should be adjusted. This can be done by loosening the clamps and raising or lowering them to the most convenient position. Before making any adjustment, the wall switch should be opened. The bolts fastening the copper leaves to the transformer and the copper electrode holders should be carefully tightened after the machine has been submitted to severe usage. The sliding head should be well oiled and the grooves kept clean. The movement of the electrodes or the up and down movement of the foot-treadle or hand-lever is adjusted by means of screw *C* located on the front of the machine, which comes in contact with a dog connecting the foot-treadle or hand operating mechanism.

Welding Processes accomplished on Electric Spot-welding Machines

The electric spot-welding machine, in addition to being used for spot-welding sheet metal, can also be used for a variety of other processes. In electric spot-welding practice, the copper electrodes are used to fuse the two sheets of metal together at localized points. The action which takes place is clearly indicated at *A* in Fig. 2. Here it will be noticed that before making the weld the two electrodes are brought into contact with the sheets. In making the weld, the upper pointed electrode is depressed into the upper sheet, as shown, and the two sheets welded together at the point indicated by the double cross-hatching.

At *B* is shown the method of welding known as point- or projection-welding, which differs from spot-welding in that the material must be provided with projections. These projections are brought into line with each other, and when the electric current is applied, the resistance, being greatest at the contact points, causes them to quickly reach a welding temperature, and upon the application of pressure the two sheets are welded at the contacting points.

At *C* is shown another application of the spot-welding machine. In this case it is being used for making what is known as a ridge-weld. This requires previous preparation of the material, and the material is disposed, as shown, between the electrodes with the ridges forming a cross. In this case, the electric current is also confined to the spot where the contact is made, and when the current is turned on and pressure applied, the metals are welded together.

Still another application of the spot-welding machine is indicated at *D*. This process is known as button-welding, because of the practice of using one or more "buttons" to localize

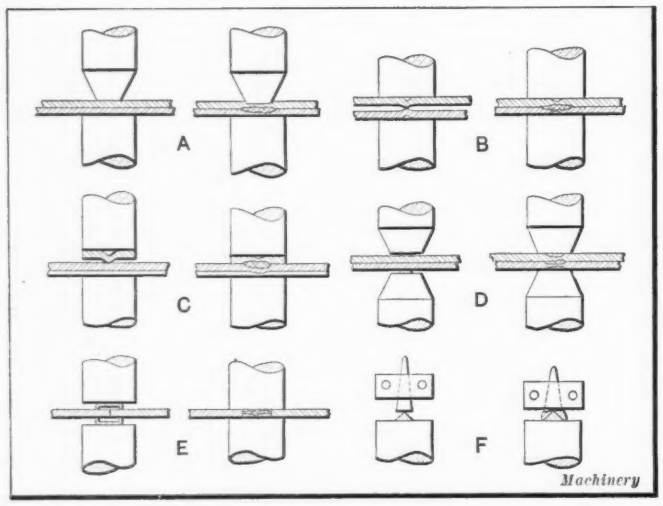


Fig. 2. Diagram illustrating Various Processes of Electric Welding accomplished on Electric Spot-welding Machines

the current. This is particularly advantageous for welding thick sheets that cannot be brought into intimate contact by the copper electrodes. In this case the buttons or disks of metal are interposed between the opposing faces of the electrodes and the pieces to be welded, and thus localize the current, causing the metal to quickly reach a welding temperature. Upon the application of pressure the highly heated buttons are pressed into the sheets and form a solid junction. There are many applications of this button method, some of which will be described later.

The process of welding shown at *E* is known as bridge- or tie-welding, because of the shape of the parts used to unite the two sheets. In a sense, this method could be called butt-welding, because the two sheets being welded are butted together, a junction being made between them by employing two channel-shaped pieces which overlap the ends of the sheets. When the electrodes are brought in contact with the work and the electric current turned on, these two pieces localize the current and offer sufficient resistance to cause them to heat; then upon the application of pressure they are forced into intimate contact and become one with the pieces to be welded.

Another process that is used quite extensively in the agricultural implement industry is shown at *F* in Fig. 2. This method is known as tee-welding, and is shown applied here to the manufacture of garden rakes. The same principle is employed as in the case of point-welding. The back or frame of the rake is made with a knife edge, and in this way localizes the current, so that sufficient resistance is offered to the flow of the electric current to fuse the metal and allow the prong to be forced over the back of the rake and united with it. There are many different applications of the principles described in the foregoing, some of which will be illustrated later.

Materials that can be Satisfactorily Spot-welded

As the satisfactory welding of two pieces of metal depends upon their relative resistance to the flow of an electric current, such metals as copper, silver, aluminum, etc., are difficult to spot-weld. The reason for this is that they offer no more resistance to the flow of the electric current than the electrodes themselves, and hence difficulty is encountered in getting a welding heat. Pure aluminum cannot be commercially spot-welded, but by the addition of a small percentage of machinery steel, or 20 per cent of zinc, satisfactory welding is possible. Galvanized iron can be welded, although it will burn off the zinc at the spot where the weld is made, and this method is not recommended for welding very thin galvanized iron, as there is no body of metal to work on. By the time the zinc is burned off there is nothing left; 28-gage (0.0156 inch thick) galvanized iron and heavier can be welded without difficulty. When the galvanized iron sheets are very thin—below 0.015 inch—the button method of welding can be used to advantage.

Cast copper can be electrically welded to steel, brass, sheet copper, wrought iron and galvanized iron, but the process is limited almost exclusively to butt-welding. The surface of the cast copper becomes crystallized to a considerable extent when spot-welded, and therefore this method is commercially impractical for spot-welding. Sheet steel or brass cannot be commercially electrically welded to cast iron, because cast iron is usually very impure and the section at the weld becomes crystalline in structure. Tin can be welded to tin or to sheet iron, but the stock will be discolored at the weld. Sheet brass and bronze can be welded to sheet brass or to sheet steel. There is a little knack in this kind of work in knowing just what pressure and temperature is necessary, and the automatic switch must be very accurately set.

Practically all metals and alloys can be electrically welded, but the process is limited in many cases to butt-welding. Butt-welding is easily accomplished on all sorts of materials, copper and other good conductors of electric current being no exception. Spot-welding of copper is very difficult, owing to the small amount of metal that is actually brought into contact. In butt-welding, a large amount of metal can be used, and the fused metal thrown out into the burr. In spot-welding this is not possible. Copper must be welded very rapidly. It requires more current and less time.

Alloys containing tin are very difficult to spot-weld, brass to aluminum being particularly so. These metals are affected with what is known as "tin" disease. Brass welded to aluminum will hold together for a short while, but soon becomes disintegrated because of the tin composition. In fact, a weld can be successfully made in brass and aluminum, and shortly after the weld has been made the joint will be strong, but after lying exposed to the atmosphere for twenty-four hours or more, the metals can easily be pulled apart again. The theory is that the tin composition in the brass comes to the surface of the metal and acts as an oxidizer, preventing perfect union between the metals. After exposure to the air, the structure of the metal all around the weld becomes disintegrated.

German silver, monel metal, zinc, nickel and alloys of many kinds are easily welded. In some cases it requires a special preparation of the material, or various shapes of electrodes, and in some cases it is necessary to change the transformer in the machine, in order to get a heavy current over a short period of time. Malleable iron of good quality can be welded to sheet steel, but it will not stand as great a strain as rolled steel or iron. In welding heavy gages of sheet steel where the material is badly buckled, the adjacent surfaces cannot be made to contact by means of the electrodes. In cases of this kind the foot pressure used to force the uneven surfaces together would trip the switch before a weld could be made. To take care of this condition a hand-operated switch *B*, Fig. 1, is brought into use, as previously described. With this device it is possible to do work that could not be done with the regular automatic switch.

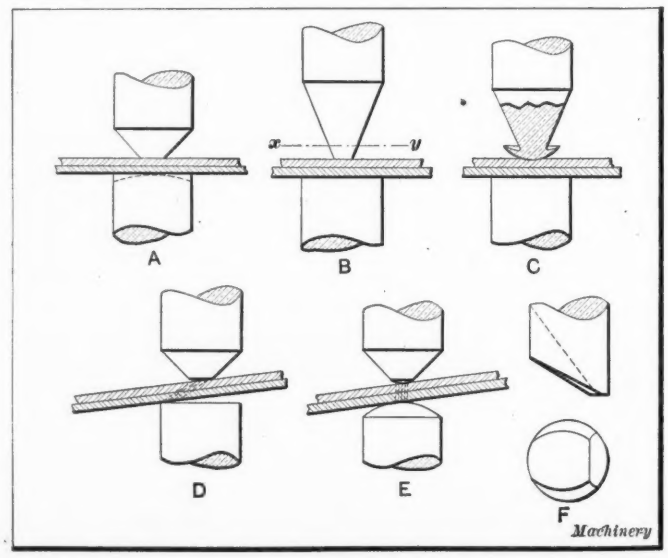


Fig. 3. Shape of Electrode Points used on Electric Spot-welding Machine for Various Purposes

Relation of Time to Current and Pressure in Spot-welding

There are four vital points that must be taken into consideration in making a satisfactory spot-weld. They are: (1) condition of stock, whether pickled, oxide-coated, coated with zinc, lead, etc.; (2) time required to make the weld; (3) pressure on the electrodes, which should bear a direct relation to the current used and the time taken to make the weld; and (4) amount of current passing through the secondary circuit. An increase in the pressure necessitates an increase in the amperage of the current; and the smaller or lower the amperage, the greater the length of time required to complete the weld, and *vice versa*. As the thickness of the stock increases, the pressure and current should be increased. Using a low current and heavy pressure will not give a perfect weld, and a heavy current and low pressure will burn the metal. For example, suppose the metal to be welded is 1/16 inch thick pickled sheet steel. The pressure should be 200 pounds, the current 10 kilowatts, and the time one second. This will give a perfect weld if the electrode points are properly shaped. In welding an oxide-coated stock, the usual practice is to increase the pressure over that required for welding pickled stock. In welding 16-gage mild steel, having a scaled or black hot-rolled surface, the pressure would be increased from 50 to 100 per cent, or from 300 to 400 pounds, the current 10 to 12 kilowatts, and the time one second. In welding a zinc, lead or aluminum-coated stock, the pressure and time should be decreased. For example, in welding 16-gage aluminum-coated steel, the pressure should be 100 to 150 pounds, current 10 kilowatts, and the time ¾ second. Pure aluminum, as previously stated, cannot be spot-welded.

Method of Determining Pressure Required

To determine the pressure required to make a satisfactory spot-weld, a regular platform scale is placed in front of the electric welding machine in such a position that a bar can be placed between the upper or movable member of the machine and the platform. Experiments are then made on small pieces of sheet metal of the same thickness as that to be welded until the required pressure, time and current have been determined. As has been previously mentioned, the amount of current can be controlled by moving the regulator pointers. The correct pressure, however, is a little more difficult to determine. To be certain that the welded joint is satisfactory, the metal should be sectioned and a microscopic examination made.

The way in which the necessary adjustments are made can be seen by referring to Fig. 1. For regulating the time that the current is on, screw *D* is adjusted. Turning this screw to the right shortens the time, and turning it to the left lengthens the time. This screw controls the position of automatic

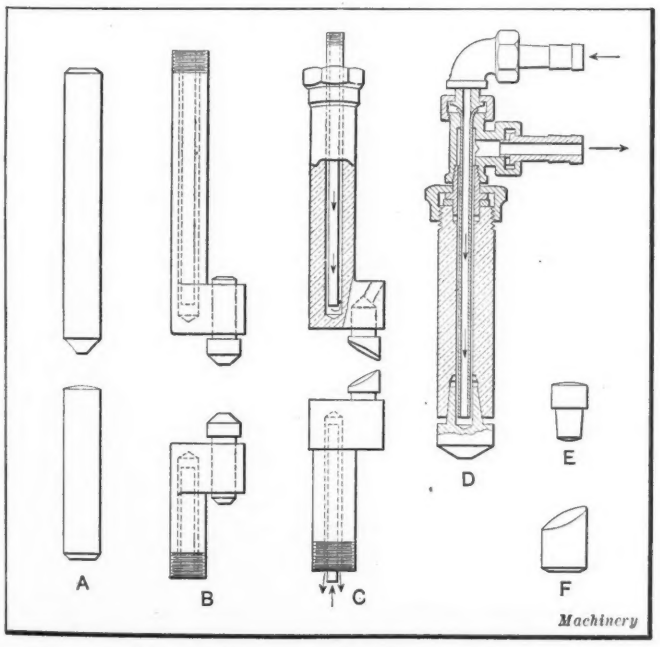


Fig. 4. Method of holding and cooling Electrode Points on Electric Spot-welding Machines

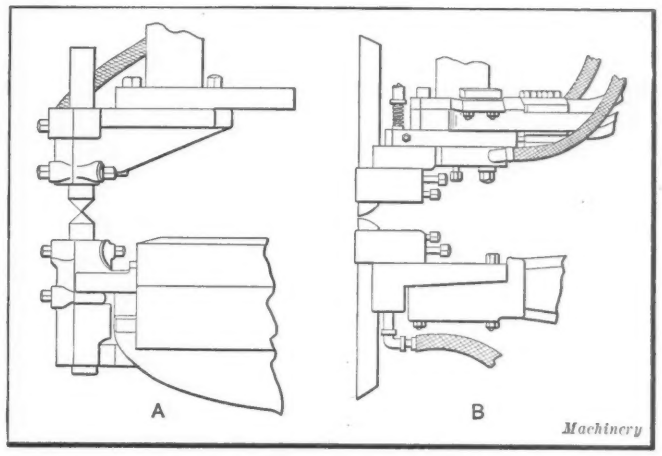


Fig. 5. Two Types of Electrode Holders

switch *E* which operates the solenoid switch *F*. To vary the pressure on the work, screw *G* is adjusted. This screw is loosened for light work, and tightened for heavy work. In addition to obtaining the proper adjustment for time, pressure and current, the electrode points should also receive attention. In the first place, the points should be properly shaped, the correct shape depending upon the material to be welded, as will be subsequently described. For welding pickled steel, the electrodes should be so set in the holders that when the two pieces of metal are placed between the contact points, the toggle joint *H* in the head of the machine stops just forward of the center. In welding brass, galvanized iron, tin, terne plate, German silver, aluminum, sherardized steel, and all coated materials, it is advisable to use less pressure between the electrode points. This can be done by setting toggle joint *H* forward to a more acute angle and loosening the tension on the compression spring by adjusting screw *G*.

Shape of Electrode Points

In spot-welding sheet metal, various shapes of electrode points are used. In most cases the shape is governed either by the kind of material being welded or the position in which the weld is being made. For welding sheet steel to sheet steel, the lower electrode point is generally left flat or slightly convex, as shown by the dotted line at *A* in Fig. 3, whereas the upper electrode point is pointed, the diameter of the point varying with the thickness of the sheet, as shown in the accompanying table. In welding tin, lead or zinc-coated stock, or galvanized iron, both upper and lower electrodes are pointed. The reason for this is that coated stock is more difficult to weld than uncoated material, and the aim is to confine the weld to as fine a point as possible to obviate burning. The shape of the electrode point should receive careful attention for several reasons. In the first place, an improperly shaped point will not last nearly as long as one that is properly shaped; and in the second place, an improperly shaped electrode will not produce a satisfactory weld.

Many machine operators make the point of the electrode too long. Reference to *A* and *B* in Fig. 3 will make this clear. Here the electrode at *A* is correctly shaped, lasting considerably longer and producing better welds than the point shown at *B*. The point shown at *A* has much more body and will stand up to greater pressure without upsetting than the point at *B*. The reason for this is that in using the point at *B*, the extreme end is made hotter than the portion just back of it on the line *x*–*y*, and when pressure is applied, an upsetting action takes place because of the lack of resistance, causing the point to upset and flare, as shown at *C*. When the point is upset as shown at *C*, it will produce an unsatisfactory weld.

The remarks just made apply more particularly to the upper electrode, which is generally pointed for welding all materials, but they also apply to the lower electrode when the latter is used for welding coated stock. When pickled sheet steel is being welded, the lower electrode is not pointed, but is generally made flat. When large articles are being spot-welded, it is better practice to make the lower electrode slightly convex instead of flat. The reason for this is that it is difficult

to hold large articles so that the surfaces contact perfectly with the flat face of the electrode. If the work is not properly located, as shown at *D* in Fig. 3, a scar will be produced on the lower surface of the work. This is caused by the work bearing on one edge of the lower electrode only, and the current, instead of flowing straight or following the axes of the electrodes, shoots off at an angle, and in most cases produces an unsatisfactory weld. The diagram at *E* shows what takes place when the lower electrode is slightly convex and the work held at an angle. It will be seen that although the work is not held correctly, it does not produce an imperfect weld, as a point instead of a "line" contact is secured.

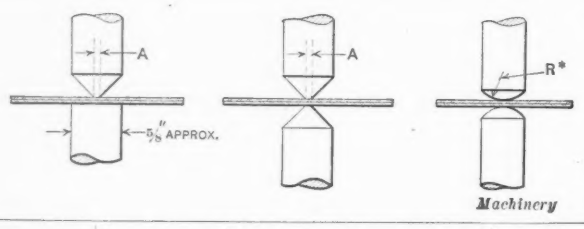
The electrode point shown at *F* is used for getting in close to the edge of a box or corner. The point shown by the full lines will last much longer and make a better weld than the point indicated by the dotted line, because it will withstand a greater pressure without upsetting.

Methods of Holding and Cooling Electrode Points

Electrodes for spot-welding machines are made as a rule from round bars of copper about ¾ to 1½ inch in diameter when of the solid type, and smaller (⅝ inch diameter) when of the inserted type. As illustrated in Fig. 4, that shown at *A* is known as the solid type, and is held in water-cooled holders, whereas those shown at *B* are of the inserted type or tip construction, and are held in water-cooled holders by means of a tapered shank as illustrated. The holders carrying the electrodes are connected by a ½-inch water pipe and a flexible pipe to a water main which is sufficient to supply enough water to keep the electrode points fairly cool. The return pipe is then connected with the sewer.

The type of electrode holder shown at *C* in Fig. 4 illustrates how this connection is made. The inner pipe carries the water into the holder, and it returns through the space between the hole in the holder and the inner pipe. This type of holder does not carry the cooling effect direct to the electrode point, and therefore is not as effective as the holder shown at *D*. Here it will be noticed that the electrode tip is inserted directly into the holder and is drilled out for the insertion of the cooling pipe which can be brought almost to the end of the electrode. The arrows indicate the direction in which the water flows. *E* and *F* show two types of electrode points. The one shown at *E* is used for welding average stock, whereas the one at *F* is used for getting into corners. There are many different types and shapes of electrode points in use, but those shown in the illustration represent some of the more common ones.

DIAMETER OF ELECTRODE POINTS USED IN WELDING SHEET STOCK OF THE SAME THICKNESS



No. of Gage, U. S. Standard	Thickness, Inches	Decimal Equivalent	Wrought Iron or Sheet Steel	Galvanized Iron
			Diameter of Point A in Inches	
0	5/16	0.3125	7/16	....
1	9/32	0.2813	7/16	....
2	17/64	0.2656	7/16	....
3	1/4	0.2500	7/16	....
4	15/64	0.2344	3/8	....
5	7/32	0.2188	3/8	....
6	13/64	0.2031	3/8	....
7	3/16	0.1875	5/16	3/8
8	11/64	0.1719	5/16	3/8
9	5/32	0.1563	5/16	3/8
10	9/64	0.1406	1/4	1/4
11	1/8	0.1250	1/4	1/4
12	7/64	0.1094	1/4	1/4
14	5/64	0.0781	1/4	3/16
16	1/16	0.0625	3/16	3/16
18	1/20	0.0500	3/16	3/16
20	3/80	0.0375	3/16	1/8
22	1/32	0.0313	1/8	1/8
24	1/40	0.0250	1/8	....
26	3/160	0.0188	1/8	....
28	1/64	0.0156	1/8	....

* For electrodes ⅝ inch diameter, radius "R" varies from ⅜ to ½ inch.

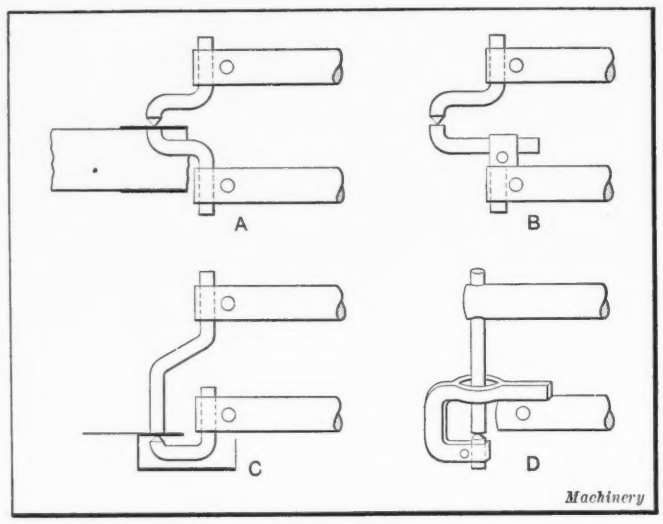


Fig. 6. Diagram illustrating Several Different Types of Electrode Horns

Construction of Electric Welding Machine Horns and Electrode Holders

The type of electrode holder or horn used on a spot-welding machine is governed almost entirely by the kind of work to be welded. There are, however, several standard types of holders which are capable of being applied to a large class of work. The holder shown at *A* in Fig. 5 is known as the heavy-duty machine type of holder. This, as will be seen, is rigidly constructed and is provided with a solid type of electrode, the cooling pipes being connected directly to the holders themselves.

Another type of standard holder is shown at *B* in Fig. 5. This type of holder is used for semi-heavy stock and is principally adapted for electric welding operations where it is necessary to get into a corner. It will be noticed here that the electrode points are so shaped that the welding can be done at the extreme edge. The construction of this holder does not differ materially from that shown at *A*, except that it is not as heavily and rigidly built.

Several forms of electric welding machine horns are shown in Fig. 6. The type of horn shown at *A*, which carries bent upper and lower electrode points, is used for such work as the welding of automobile muffler tubes, where it is necessary to carry the weld in at some little distance from the end of the tube. The type of electrode horn shown at *B* is of a somewhat similar construction, but is much more effective for constant use, as it is possible to bring the cooling pipes or water closer to the point where the welding is being accomplished. Where the welding machine is being used continually, this is a factor that must be considered.

The type of electric welding horn shown at *C* in Fig. 6 is

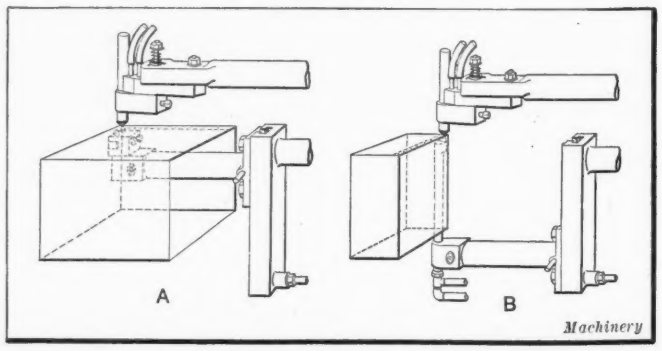


Fig. 7. Diagram illustrating Two Different Types of Electrode Horns for welding Boxes

of unusual construction, and it will be noticed that the lower electrode instead of the upper one is pointed. This horn is used for welding a plate onto a channel, as illustrated. The horn shown at *D* is of rather unusual construction and is chiefly employed where it is necessary to use a small electric welding machine for welding large, thin work. This greatly increases the capacity of the machine between the column and the electrode points, and welds the channel section shown at *C* in the reversed position.

Fig. 7 shows two applications of electric welding machine horns. At *A* is shown a type of horn which can be used for welding along the corner of a box, one of the electrode horns extending into the box and the other working on the top edge. The type shown at *B* is of slightly different construction, in that the welding, instead of being done in a position extending out from the machine, is done in a horizontal position in the machine, and makes necessary the use of an extended lower electrode holder. There are many other applications of electric welding machine horns, but the principal ones are illustrated here.

* * *

WELDING 13-FOOT TUBE SHEETS FOR SUGAR EVAPORATORS

An acetylene welding job that is decidedly out of the ordinary has just been completed by the Treadwell Engineering Co., Easton, Pa. This company makes, among other products, sugar evaporators, and the plates that were welded were to be used as tube sheets in this machinery. In a sugar evaporator, plates of this kind are used for supporting the copper tubes through which the sugar juice to be evaporated circulates. The tubes are, of course, expanded into the holes in the plates, and form steam-tight joints. The steam circulates on the outside of the tubes. Fig. 1 shows one of the completed tube sheets which is 13 feet in diameter. The thickness of the plate is ¾ inch and the material is ingot iron, having a low carbon content and non-corrosive qualities. In each plate, there are 2618 1¾-inch holes. These plates are made in halves on account of the size, as it is impracticable to secure one rolled piece 13 feet in diameter. The welding consisted in joining these halves.

The welding was done with a Davis-Bournonville welding torch, as shown in Fig. 2. One factor that had to be taken into consideration was the expansion of the plates from the heat. Preparatory to welding, the halves of the plate were placed in contact at one edge, but an opening of three inches was left at the opposite side. The welding was started with the plate in this position, but as the operation progressed the heat caused the sheet to expand and the joint to "creep" together. An experienced operator was required for welding these plates and when the operation was started, it was necessary to keep the welding continuous, without interruption, until completion. The time required for making the weld in one tube sheet was six hours.

C. L. L.

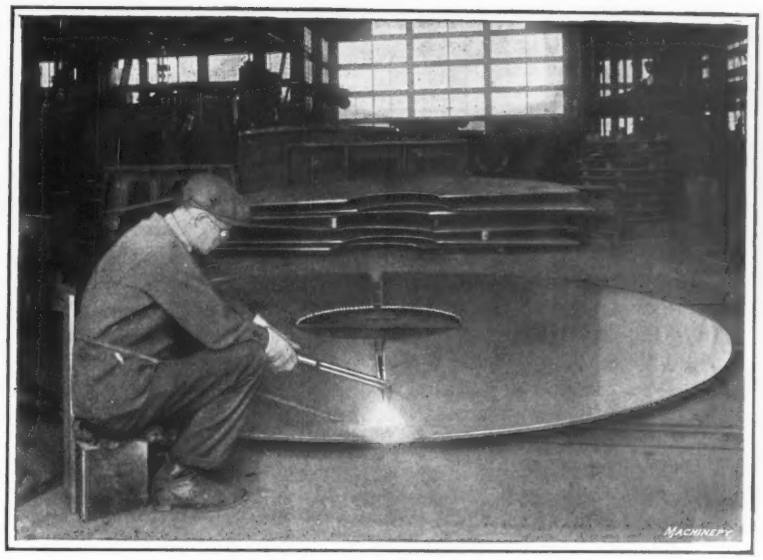


Fig. 2. Welding One of the Tube Sheets

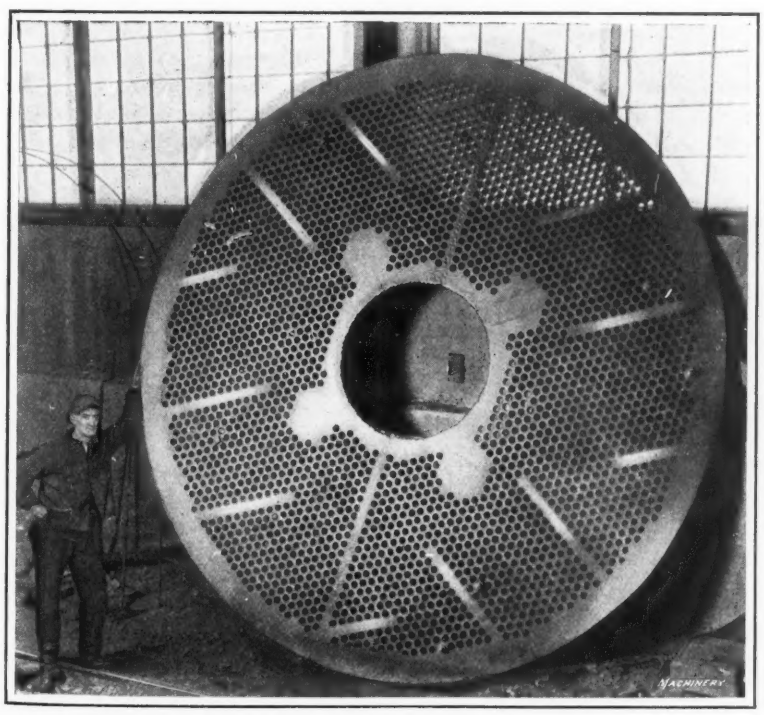


Fig. 1. One of the Welded Tube Sheets

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USE OF INDIA INK IN FOUNTAIN PENS

BY W. F. SCHAPHORST*

Despite a somewhat general belief to the contrary, it is quite possible to use India ink successfully in fountain pens; and the ink will not clog, even if it is left in the pen for a long period of time. The principal precaution to be observed is not to allow the pen to dry at the point; keep it working or moist all the time, and plug the holes in the cap to exclude air while the pen is not in use. In putting the pen away, care must also be taken to see that the cap is on tight. These precautions are necessary in order to prevent evaporation, which would cause the ink to become thick and clog the pen. It is well to dip the pen point in water before putting it away, allowing as much water as possible to cling to the point. This additional moisture will effectually prevent the ink from drying on the point of the pen, because the cap is tightly sealed. In filling a fountain pen with India ink, it is important not to take ink from the bottom of an old bottle that has been left open, as such ink is often very thick and would be likely to clog the pen. Use only fresh ink and take it from the top of the bottle. If these instructions are carefully observed, no difficulty will be experienced in using black India ink in an ordinary fountain pen.

* * *

The common plan of setting lathes parallel with the lineshaft and using countershafts is being generally discarded with lathes having individual motor drives or single-step pulley belt drives. With either of these drives the lathes may be advantageously set at right angles to the bays of the shop, as more can be accommodated and better service can be rendered in taking work to and from the machines. Quarter-turn belts running from the lineshaft pulleys to the single-step pulleys on the belt-driven lathes run satisfactorily. There is less overhead work, and less light obstructed. The lineshafts should, of course, be broken into short sections, each driven by a motor.

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DESIGN OF AUTOMATIC MACHINERY

BY JOSEPH W. WUNSCH*

It is not the purpose of this article to discuss the subject of how to design a machine, as this is adequately treated in many text-books; the object of the following is, rather, to formulate the technical routine of procedure in designing. I do not claim that the following elementary outline is not open to individual modification, but that in its fundamental elements it is the only logical way to proceed. Especially is this true of the class of machinery to which I have particular reference, namely, special automatic machinery.

Following are eight successive steps in the design of a machine, many of which are essential to every design, others being dependent on the complexity of the machine: (1) preliminary diagram; (2) preliminary lay-out; (3) final diagram; (4) design; (5) detail drawings; (6) partial assembly drawings; (7) unit assembly drawings; (8) general assembly drawings.

Preliminary Diagram.—Fig. 1 illustrates a preliminary diagram, which is nothing more than a graphical illustration of the problem. This drawing is usually essential in designing special machinery, and should illustrate the prime movements required of the machine. The time of one cycle of the machine (360 degrees or more) is the abscissae, and the magnitudes of the movements are the ordinates.

Preliminary Lay-out.—This drawing should be an approximate plan of the machine, embodying the essential mechanisms for the movements outlined on the preliminary diagram. It should be a skeleton of the ultimate design, as an architect's model is of the final construction. From this lay-out the patent draftsman should be able to prepare patent office drawings to accompany the specification, and it should be sufficiently clear to enable an engineer to render an opinion as to the merits of the machine.

No machine designer can be entirely familiar with all the materials which his machines may be called upon to handle. It is therefore highly essential, before involving much expense in the design of a new machine, for an expert opinion to be obtained as to the workability of the material under the given conditions. Thorough experimentation is often necessary, and is, of course, more certain than an expert's opinion. We are all familiar with the fact that every substance has its individual characteristics under different conditions, and many a machine, the mechanical functions of which were properly designed, has landed in the junk-shop, due to lack of understanding of the substance in hand.

In this type of drawing, symbols and center lines often suffice to indicate commercial stock and standard parts. Here in the early stage of the design, the advantages of a system of substitutible elements are evident. In fact, although I am not confident that the stage in machine construction will ever be reached when it will be possible to build machines without drawings, yet if such a stage is ever approached, it will only be through the universal employment of substitutible machine elements.

Final Diagram.—Fig. 2 illustrates a final diagram. This is distinguished from the preliminary diagram, inasmuch as it must be accurate and final, and it may readily be differentiated by the variations in movement and timing that have been introduced. It should embody all changes that have been suggested by discussion, and with it a competent designer should be able to design the machine. In many cases, of course, a second diagram will not be necessary.

Design.—At this stage, the designer should, of course, be thoroughly familiar with each function of the machine. With the aid of the final diagram, he has a graphical picture of the timing and magnitude of every prime movement, and he can proceed to design the machine. Standard parts, standard screws, bolts, nuts, stock gears, and standard drop-forgings should, of course, be used whenever possible. The design should always be full size and accurately scaled. Stock parts need not be drawn out in detail, but should be clearly indicated to the detail draftsman. Necessary views should be shown and principal dimensions indicated.

Detail Drawings.—It would be difficult to overestimate the importance of proper execution of detail drawings. They should be full size whenever possible. A full size drawing is very helpful to the patternmaker. All necessary views should be shown and no more. Proper finish, material, and number required should be clearly noted, and all dimensions plainly indicated so that no figures will have to be indirectly obtained by the patternmaker or machinist. In complicated castings, it is often desirable to make a separate detail drawing for the patternmaker. This facilitates the reading of both drawings, inasmuch as the dimensions in which the patternmaker only is interested are not on the machinist's drawing and *vice versa*. This is often the means of saving costly mistakes in the shop.

Partial Assembly Drawings.—These are of service where size or complication does not permit of adequate checking of details and clearances on the general assembly drawing. They show neighboring parts and units without relation to their functions.

Unit Assembly Drawings.—Unit assembly drawings represent assembled independent units. By an "independent unit" is meant all parts belonging to a particular function. Besides being an excellent means of checking for clearances and correct fits, they are a great help in the shop when assembling.

General Assembly Drawings.—These show parts and units in their relative positions. They are useful as a means for checking for clearances and as a general guide in the shop. All details should be identified by numbers. Principal dimensions and center to center distances should be indicated. Invisible parts, if they are explanatory, should be shown in dotted lines, and then only in their essential outlines. A list of parts with corresponding drawing numbers should accompany every set of drawings. This is as essential as an index to a text-book.

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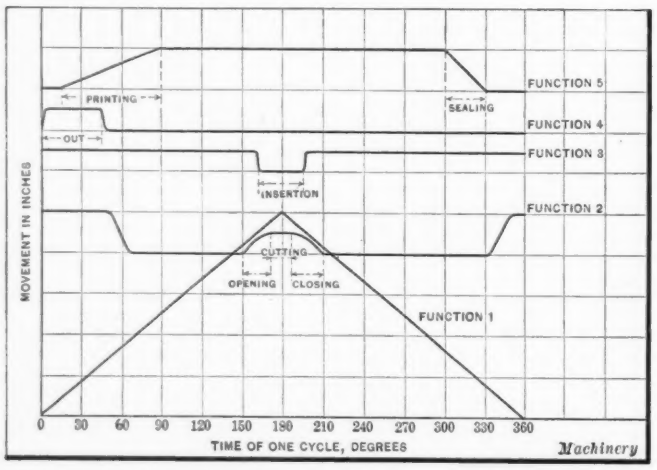


Fig. 1. Preliminary Diagram in which Abscissae represent Time of One Cycle and Ordinates represent Magnitude of Movements

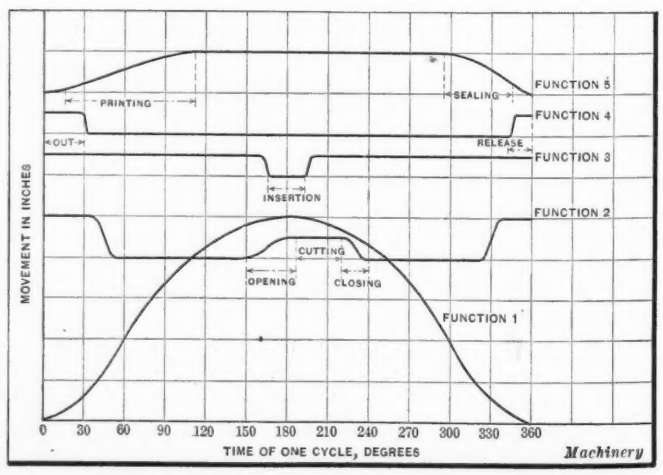


Fig. 2. Final Diagram in which Variations in Movements and Timing have been introduced since Preliminary Diagram was drawn

PRESS TOOLS FOR MAKING SHEET STEEL CORSET STAYS

The Taylor-Shantz Co. of Rochester, N. Y., has recently completed for one of its customers a set of press tools for

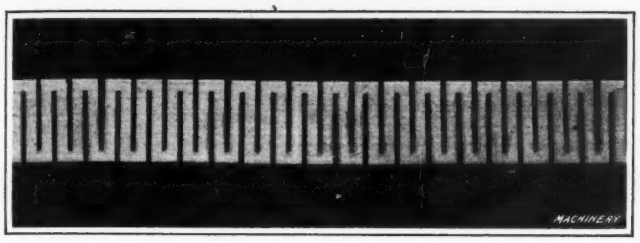


Fig. 1. Section of Finished Corset Stay

manufacturing sheet metal corset stays in continuous strips, a section of which is shown in Fig. 1. The stock is fed through a press where the slotting is done, and the finished perforated strip is coiled on the opposite side of the press, as illustrated in Fig. 2. The steel ribbon on which the work is performed comes in various widths and thicknesses, that of the sample shown being 9/16 inch wide and 0.034 inch thick. It will be noticed from Fig. 1 that the perforating consists in punching out slots alternately from a point 1/16 inch from each edge of the strip and punching across to the opposite edge. The result is an extremely flexible piece of ribbon steel that may be bent freely in any direction. The steel strip is afterward hardened by a special process that gives it still greater flexibility and at the same time a long life. The perforated slots are 0.035 inch wide and they are spaced 1/16 inch apart.

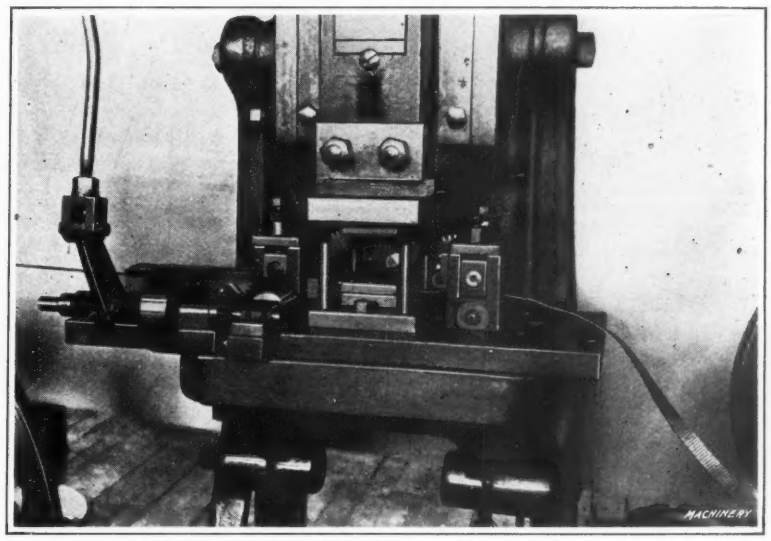


Fig. 2. Press equipped with Tools

Referring now to Fig. 2, where the tools are shown in position in the press, it will be noticed that the punching is performed by piercing eight perforations at each stroke of the press, which covers a section of the strip seven-eighths inch long. After one section has been punched the next operation of the press brings the stock forward another seven-eighths inch and the strip is held stationary while another eight slots are punched. The feeding and holding of the stock are accomplished through the roll feed on one side of the press that advances the strip and the receiving rolls on the opposite side that guide the strip as it emerges from the dies. These two pairs of rolls are geared together, and both are operated through a crank feed from the end of the crankshaft of the press as shown in the illustration. The crank feed rotates a pair of bevel gears that transmit motion to the stock feeding rolls and thence to the receiving rolls by the spur gears that are shown behind the die in Fig. 2. A friction clutch on the bevel gear shaft permits the use of this intermittent type of feed and obviates all backlash. This is an important feature, as any variations in the feed would produce an irregularly punched strip. Fig. 3 shows the die in section and end elevation and also shows a plan of the punches in operation. The die is of the sub-press type.

As any die designer will appreciate, the chief trouble experienced in tooling up for this job was to prevent the punches breaking. The fact that the slots run out at the edges of the stock on one end and remain in the stock on the other end means that there is considerable side thrust on the punches. The stock is approximately located by the stripper and the punches are well supported in the stripper, but the punches are so delicate that they will break under a slight side strain. To counteract this thrust, the ends of the punches are shaped as shown by the end elevation in Fig. 3. The projections on the punches are for the purpose of guiding the stock on the sides and centering it between the punches. As four of the punches tend to thrust to one side and the alternate four to the opposite side, the tendency for lateral thrust is thus counteracted, with the result that very few punches break on the job. The projections on the punches are also a strengthening feature inasmuch as they extend well within the slots in the die before any cutting action takes place, and in this way each punch is well supported on the side against which the thrust would come.

The press operates at a speed of one hundred and twenty-five revolutions per minute and automatically produces the finished strip at a rate of nine feet per minute. No operator is needed except for starting a new coil of stock. C. L. L.

* * *

FIRST CHINESE TYPEWRITER

The first Chinese typewriter has just been designed by Hou Kun Chow, a graduate of the Massachusetts Institute of Technology. It is operated by placing a pointer opposite a character printed on the flat indicator at the front of the machine and then pushing in a plunger with the thumb. The movement of the pointer operates a cylinder, about 6 inches in diameter and 18 inches long, that carries 4000 zinc Chinese characters, and places the desired character into the proper position for printing. Pushing the plunger causes a hammer to strike the paper against the type with sufficient force to produce several carbon copies. The pulling in and out of the rack to which the pointer is attached rotates the cylinder, and pushing it back and forth moves the carriage. The striking mechanism is operated by the same impulse that moves the hammer. While it is not possible to obtain great speed with this machine as now made, Mr. Chow thinks it will become popular in Chinese offices where copies of Chinese documents must be made; also among Chinese in foreign countries where it is difficult or impossible to secure skilled Chinese writers. The present machine weighs 40 pounds, but improvements now being made will probably result in reducing the weight of the machine to 20 pounds.

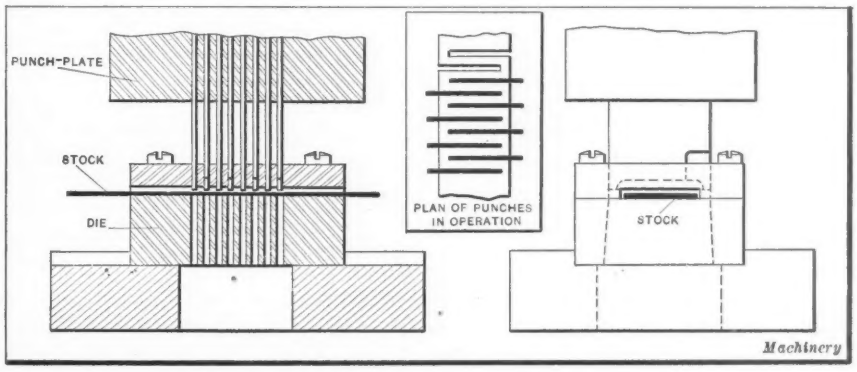


Fig. 3. Die in Section and End Elevation

TABLE I. SPECIFICATIONS AND RESULTS OF TESTS OF COMMERCIAL BRONZE AND BRASS CASTINGS

Nos. of Alloy	Name of Alloy	Composition								Tensile Test					Hardness		Compression Test	
		Copper, Per Cent	Tin, Per Cent	Zinc, Per Cent	Lead, Per Cent	Aluminum, Per Cent	Iron, Per Cent	Manganese, Per Cent	Phosphorus, Per Cent	Yield Point§	Elastic Limit§	Ultimate Strength§	Elongation in 2 In.	Reduction of Area	Brinell	Scleroscope	Elastic Limit§	Compressed Height, Percentage‖
1	Bronze	80	20						tr.						136			3.1
2	Grade "A" bridge bronze	80	20						1 (*)								25–40	6–10
3	Special phosphor-bronze..	80	20						0.2 (†)								24 (†)	
4	Grade "B" bridge bronze.	85	15						1 (*)								19–23	12–25
5	Special phosphor-bronze..	99							1 (*)								19–23	12–16
6	Hard bronze	82.5–83.5	13.8–14.2	1.1–2.9	0.8–1.2						15–19	23–27	tr.–4	tr.–4		20–24		
7	Gear bronze	85	13	2						23–25		37–39	2–3	1–4				
8	Phosphor-bronze	79.5	12		7.5				1			30–34	1–2		74–80			
9	Tough bearing bronze....	85.5–86.5	10.5–12	1.5–3.5	1 (*)		0.25 (*)	0.15 (*)			15–20	24–32	2–15	2–15		15–22		
10	Stone's English gear bronze	89	11							22–25		35–40	6–10	7–9	80		15.5–16.5	25–27
11	Gear bronze	89	10.5						0.5			31–35	6–10		72–77			
12	Cast gun metal, "G," U. S. N.	87–89	9–11	1–3	0.2 (*)		0.06 (*)			15 (†)		30 (†)	15 (†)					
13	Tough bronze	85.7–89.3	9–11	1.5–2.5	0.3–0.8						12–16	26–34	10–22	9–21		14–18		
14	Gun metal bronze	86–89	8–11	1–3								33 (†)	14 (†)					
15	Bronze	88	10	2								32–38	14–18		70–74			
16	Grade "D" bridge bronze	88	10	2					0.25 (*)			33	14				14 (†)	
17	Gun metal	88	10	2						19–23		32–38	14–18	12–15	70–75		14.5–15	27–29
18	Bronze 2, U. S. N.	87–91	8 (†)	4 (*)	1 (*)		0.5 (*)		0.5 (*)			30 (†)	15 (†)					
19	Cast phosphor-bronze, Pc. Grade 1, U. S. N.	85–90	6–11	Remainder	0.2 (*)		0.06 (*)		0.3 (*)	25 (†)		50 (†)	25 (†)					
20	Bronze	90	10							22–24		35–40	15–18	15–20	65–70		15.5–16	28–29
21	Bronze	90	10						tr.			32–36	10–14		67–70			
22	Bronze‡	89.5	10					(Included									15	
23	Bronze	89	10		1			in				22					22	
24	Bronze	88	10		2			Copper)		19–23		30–35	15–20	18–26	65–70		15	28–29
25	Cast phosphor-bronze, Pc. Grade 2, U. S. N.	78–81	9–13	Remainder	8–11				0.7–1	20 (†)		35 (†)	18 (†)					
26	Bronze	79.7	9–11		8–11				0.7–1								15–20	
27	Phosphor-bronze	80	10		10					20		30	6					
28	Phosphor-bronze	79.75	10		10				0.25			28–32	5–7		65–70			
29	Grade "C" bridge bronze.	80	10		10				0.7–1								15–20	
30	Bronze	80	10		10				0.8								18	
31	Phosphor-bronze	80	10		10					19–21		28–32	5–7	6–10	55–60		11.5–12	33–35
32	Bronze	80	9.2		10				0.8								27	6.25
33	Bronze	84	9.5		6.3				0.2			29–33	8–10		59–61			
34	Bronze	88	8	2	2							31–37	16–20		57–59			
35	Free-machining bronze...	87.8–89.8	7–7.8	0.4–3.4	1.5–2.3						11.5–15.5	21–31	11–15	7–13		8–12		
36	Bronze	81	7	3	9					19–20		30–35	15–18	22–24	50–55		12.5–13	34–35
37	Bronze	78	7		15					17–18		28–31	12–18	17–23	48		11–12	38–39
38	Bronze	90	6.5	2	1.5							34–40	25–33		54–57			
39	Bronze	90	6.5	2	1.5					18–22		34–40	25–33	26–34	50–60		12.5–13	33–34
40	Bronze	85	5	5	5							27–33	16–20		59–63			
41	Red composition, ounce metal	85	5	5	5					15–19		27–33	16–20	15–20	50–60		11.5–12	36
42	Bronze	89	5	3	3					16		34	26–31	29	40–45		11.5	34–35
43	Red brass	83	4	7	6					14–16		28–33	15–20	20–26	55–60		9.5–10	37–39
44	Red brass	85	3	9	3							23–25	16–18					
45	Red brass	83	2	5	10					10–11		19–23	7–13	11–17	34		7–8	46–47
46	Bronze, 3, U. S. N.	60–70	3 (*)	25–37	1 (*)		0.5 (*)					25 (†)	15 (†)					
47	Natural color brass	74.5–77.5	0.8–1.2	21–23.3	0.3–1.2		0.2 (*)				7–11	22–28	23–33	15–25		6.5–9.5		
48	Yellow brass	70	1	27	2					10–11		28–31	22–28	27–30	50–55		6	40
49	Yellow brass	69	1	30								28–32	22–28		57–59			
50	Bronze, 1, U. S. N.	55–62	1.5 (*)	Remainder	0.4 (*)	1.5 (*)	0.5–2	0.5–3.5				60 (†)	15 (†)					
51	Cast manganese bronze, Mn-C, U. S. N.	56-58	1 (*)	40–42	0.2 (*)	0.5 (*)	1 (*)	0.3 (*)		30 (†)		65 (†)	20 (†)					
52	Manganese bronze	57.75–58.25	0.2–0.5	38.5–39.5	tr.–0.2	0.5 (*)	1.05–1.35	tr.–0.25			26–34	56–72	18–30	22–30		17–23		
53	Manganese bronze	56	0.75	41.5		0.5	1	0.25				72–84	22–35		109–119			
54	Manganese bronze	57	1	40		0.75	1	0.1			37 (†)	75	18	22				
55	Manganese bronze	56	1	41		0.5	1	0.5		33		70	22–35	25	104–119		27.5–28.5	10–11
56	Manganese bronze	56–57	1	38–40			1.5										35–40	
57	Manganese bronze	53–62		36–45	0.15 (*)	0.05–0.5						70 (†)	20 (†)					
58	Manganese bronze	60		40						30		60	20					
59	Yellow brass	55		45								39–45	9–13		80–93			
60	Vanadium bronze, Vn-C, U. S. N.	61 (†)	1 (*)	38 (*)						22.5 (†)		55 (†)	25 (†)					
61	Tensilite	64	0.2	29		3.1	1.2	2.5		30		98	16	17	130			
62	Tensilite	67		24		4.4		3.8	0.01								60	1.33
63	Titanium aluminum bronze	90				10				22–26		70	20	21	90–100		19–20	11.4
64	Aluminum bronze	90				9.9				25		71	21					
65	Titanium aluminum bronze¶	89				10	1			24–30		70	24.5	27.3	92–96		18–20	13–15
66	Cast monel metal, Mo-C, U. S. N.	Remainder			0.0	0.5	6.5 (*)	60 (†)		32.5 (†)		65 (†)	25 (†)					
67	Monel metal	27					6	67		37		78	38					

* Maximum limit. † Minimum limit. Compiled from sixteen different sources, but in each case the physical and chemical data came from the same authority. ‡ 0.5 per cent antimony. ¶ Nickel. § In thousands of lbs. per sq. in. ‖ Per cent of height remaining after loading to 100,000 lbs. per sq. in.

BRONZE ALLOYS FOR AUTOMOBILE CONSTRUCTION*

In a paper abstracted in the following, the authors point out the need for more concrete information concerning the physical properties of bronze alloys and present an extensive table covering the results of actual tests on a large range of cast bronze alloys. The influence of the method of making the test specimens is also discussed.

Experience in the bronze casting business has demonstrated the need of information on the physical and chemical properties of alloys. Tables showing such properties determined from actual practice, which may be termed "experience tables," are rare; some data exist, but they are usually in the private files of individuals or companies. The Bureau of Standards at Washington frequently receives requests for such information, and states that there is great difficulty in obtaining such data. With this need in mind, the committee on non-ferrous alloys of the American Society for Testing Materials discussed at a recent meeting the advisability of publishing such data as might be compiled from existing "experience" tables. On account of the fact that publication of data by that society is made in a formal manner, usually as specifications, it was thought best to delay action, so as to allow the tables to be checked by further work. The need was fully realized, however, and it is with that idea in mind that the accompanying tables were compiled.

Test Bars

One very important point should be emphasized in connection with the use of the tables mentioned. Most tests are made on standard test bars either attached to castings or cast separately. Test bars cut from castings, where this procedure is possible, show conclusively that a variation exists between results on standard test bars and the metal in the castings themselves. Castings may show higher or lower results, depending on the design and size of the casting itself. The results are usually lower, on account of the fact that the average size of castings exceeds the test bar size. It has been proved conclusively that the rate of cooling and the shape of the casting affect the results markedly. Alloys of high shrinkage are much more likely to show internal strains due to practical inability to feed the shrinkage properly, so that the net strength is the difference between the true value for the metal and the internal strains caused by this shrinkage. Manganese bronze, for example, normally shows an average ultimate tensile strength of from 65,000 to 75,000 pounds per square inch. It is not uncommon to find this lowered to 30,000 or 40,000 pounds per square inch in actual castings. Copper tin alloys, such as phosphor-bronzes, do not exhibit high shrinkage, but show the same proportional discrepancy in strength, on account of large crystal growth and the formation of a coarse network of the high tin eutectoid, which is very hard and brittle. Thurston, for instance, in his work on alloys, quotes from Major Wade's report of 1856 on "Experiments on Metals for Cannon," in regard to gun bronze containing 10 per cent tin, that eighty-three test bars from gun head castings averaged about 30,000 pounds per square inch in tensile strength, while thirty-two small bars averaged about 42,000. The average of twelve gun heads was one-half (in strength) of that obtained from small sample bars cast with the guns. The area of the cross-section of the casting, as well as its design, therefore, has a very important bearing on the subject and should always be taken into account in engineering work.

Improper foundry practice affects the tests of any alloy to a marked extent, so that two metals of the same chemical analysis may show very different results when handled by different foundries. The latter statement is self-evident, but many engineers do not realize the effect of small amounts of impurities, some of which are acquired during the melting process, on the final result.

Materials for Bearings

Specific statements or recommendations about materials for bearings have been avoided, because it is difficult to predict

* Abstract of paper by W. M. Corse and G. F. Comstock presented before the Society of Automobile Engineers convention, June 15, 1916.

TABLE II. USES OR APPLICATIONS OF ALLOYS GIVEN IN TABLE I

No. of Alloy	Uses, Remarks, Etc.
1	Dies, bells, bearings, etc.
2	In bridges, for contact with hard steel under pressure above 1500 pounds per square inch
3	Disks for draw bridges
4	In bridges, for contact with soft steel at pressure below 1500 pounds per square inch
5	Trunnion bearings
6	Bearings and bushings
7	Gears
8	Bushings and bearings not subjected to shock
9	Bearings, gears, etc.
10	Gears and worm-wheels
11	Worm, spur and bevel gears
12	Valves, gears, etc., and where strength and incorrodibility are desired
13	Durable castings
14	(American Society for Testing Materials tentative specifications)
15	Hard bearings, hydraulic work, valves, machine parts, etc.
16	Gears, worm-wheels, nuts, etc.
17	Bearings for heavy pressures and high speeds, thrust collars, steam fittings, hydraulic work
18	Water-tightness and bearing qualities in thin sections
19	Castings for strength and incorrodibility
20	To resist acid, and for thrust collars and disks under high pressure
21	Pumps, collars, bearings, and to resist corrosion
22	Worm-wheel rims (copper content includes manganese)
23	Worm-gearing, safe working stress: 7000 pounds per square inch
24	Gears under moderate service, easily "machineable"
25	Gun fittings
26	Bushings and shaft bearings
27	(Society of Automobile Engineers specifications)
28	Bearings for high speeds and heavy pressures
29	Ordinary machinery bearings
30	Bridge bearings
31	Standard for high speeds, heavy pressures, shock and vibration
32	Miscellaneous
33	Slide valves, bearings, and for resisting acids
34	Bearings, small valves, steam fittings
35	Gears and pump castings
36	Inexpensive bearings
37	Bearings for medium pressure and high speed
38	Bearings, steam fittings, and for incorrodibility
39	Small automobile bearings, or for high speed and heavy pressure, and steam fittings
40	Valves and bearings
41	Pump bodies, valves, steam fittings, and bearings
42	Valves, steam fittings and metal patterns
43	Valves and pipe fittings
44	Oil and water pumps, and trolley fittings
45	Inexpensive bearings for low pressure and no shocks, valves, fittings, etc.
46	Miscellaneous fittings, not subjected to friction, corrosion or pressure
47	Oil feed, cylinder top cover, etc., for automobiles
48	Light castings and ornamental work not requiring strength
49	Ornamental work
50	For strength in heavy work, substitute for steel in intricate designs, resistance to corrosion
51	Castings requiring great strength
52	Strong castings
53	Propellers, engine brass, and all strong castings
54	Strong castings
55	Propellers, valve stems, engine framing, and castings requiring strength and toughness
56	Miscellaneous
57	Ingots for castings (American Society for Testing Materials specifications)
58	(Society of Automobile Engineers specifications)
59	Low-grade bearings
60	(Tin content includes all other impurities)
61	(Single test)
62	Railroad turntable
63	For work in which strength, toughness, and especially incorrodibility are necessary
64	(Eighth report to Alloys Research Committee, British Institute of Mechanical Engineers)
65	For strength and resistance to wear, pressure, or repeated shocks
66	Fittings, etc., and castings that require great strength
67	Miscellaneous

Machinery

the result with several other variables undetermined. For instance, the hardness of the steel shaft and its finish are as much a factor in the selection of the bronze as the properties of the bronze itself. Moreover, the quality of the surface finish needed on the bronze bearing is also determined by the ability of the bronze to conform to the steel. It is evident that as the bearing pressure increases, the hardness also must increase to avoid flowing. In order to have a satisfactory hard bearing it is necessary to have a finely machine-finished surface on both bearing and shaft, because they will not conform as will softer metals.

Inasmuch as there are many different bearing conditions of pressure and speed, no one bronze can fill all the needs of the automobile engineer. In a general way tin and zinc harden bronze, and lead softens it. The use of zinc in small proportions is principally for deoxidizing purposes, but it has a detrimental effect on the wearing properties. When conditions require hard bronze bearings, the tin content must be relatively high. It sometimes reaches 15 per cent in automobile work. Lead may reach 30 or even 40 per cent for special work, such as in racing cars, but its effect should be considered in relation to the tin content as well as by itself. It is a good lubricant in bronze. Present practice frequently calls for a combination bearing with a relatively hard back and a soft lining of babbitt metal. The selection of babbitt should be determined by the thickness of the lining, and pure tin can be used if the lining is very thin.

Summary

In order to aid engineers in choosing the right alloy, the following points are especially emphasized: Results obtained from standard test bars do not necessarily represent the material in the casting. When possible, tests should be made on pieces cut from the castings themselves. Competent foundry work is necessary, as the chemical analysis of the alloy does not alone insure the best results. The microscope is as important in determining the properties of a bronze as it is in the metallurgy of steel. Endurance or fatigue tests are important in determining the qualities of a bronze. The proper composition of an alloy depends on the service required; a high percentage of tin is required for hardness, and a high percentage of lead for conformability. Authentic information on the subject of non-ferrous alloys is somewhat meager, and additional reliable information would be a distinct gain to engineering literature.

* * *

One of the noticeable changes in motor car engine design during the past six years is the decrease in cylinder bore diameters. Since 1910 when the average cylinder diameter was 5 inches, the diameter has decreased until in 1916 the average is about 3¼ inches. A curve showing the changes in average cylinder diameters was published recently in the house organ of the Burd Compression Ring Co., which showed that the diminution of diameter continued steadily from 1910 to 1912, when it was slightly more than 4 inches. The average diameter continued fairly constant at this figure until 1914, when it again dropped steadily from 4 inches to 3¼ inches.

CHART FOR DETERMINING ENGINE FRAME LOADS

BY ERNEST A. ANDREWS*

It is the purpose of this article to explain the use of a chart for finding the loads on the following members of an engine: (1) main bearings; (2) crankpins and crosshead pins; (3) crosshead guides. The horizontal line *AB* represents various values of the total load on the piston in pounds; the vertical line *CD* indicates the projected area of the main bearings in square inches; vertical line *AE* represents the projected area of the crankpins and crosshead pins in square inches; and the horizontal line *EF* shows the projected area of the crosshead bearing surface in square inches.

To illustrate the use of this chart, let us assume a case in which the total load on the piston is 24,000 pounds. This value is located on line *AB*, and assuming that it is required to find the size of the main bearings, we follow the 24,000 pound line vertically to the radial lines indicating allowable main bearing pressures. It will be seen that these lines cover a range of from 140 to 200 pounds per square inch, and assuming that we decide to use a value of 150 pounds per square inch, the radial line corresponding to this value is located, after which the horizontal line is followed across the chart to the vertical line *CD*. Here we find that the required area for the main bearings is 159 square inches. Following the same method in determining the areas for the crankpins and crosshead pins, the required values may be quickly determined from the chart, taking care to use the proper section of the chart in each case.

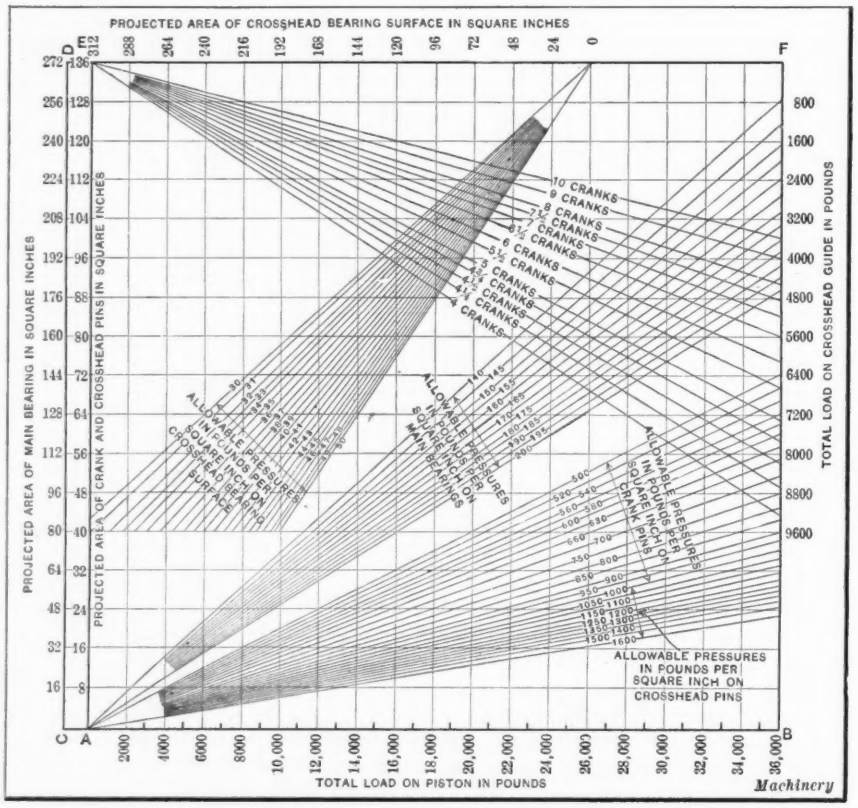

PROJECTED AREA OF CROSSHEAD BEARING SURFACE IN SQUARE INCHES
PROJECTED AREA OF MAIN BEARING IN SQUARE INCHES
PROJECTED AREA OF CRANK AND CROSSHEAD PINS IN SQUARE INCHES
TOTAL LOAD ON CROSSHEAD GUIDE IN POUNDS
TOTAL LOAD ON PISTON IN POUNDS
10 CRANKS
9 CRANKS
8 CRANKS
7½ CRANKS
7 CRANKS
6½ CRANKS
6 CRANKS
5½ CRANKS
5 CRANKS
4¾ CRANKS
4½ CRANKS
4¼ CRANKS
4 CRANKS
ALLOWABLE PRESSURES IN POUNDS PER SQUARE INCH ON MAIN BEARINGS
ALLOWABLE PRESSURES IN POUNDS PER SQUARE INCH ON CRANK PINS
ALLOWABLE PRESSURES IN POUNDS PER SQUARE INCH ON CROSSHEAD BEARING SURFACE
ALLOWABLE PRESSURES IN POUNDS PER SQUARE INCH ON CROSSHEAD PINS
Machinery

Chart for Use in rapidly determining Loads on Important Engine Frame Members

To determine the proper area for the crosshead bearing surface, it is necessary to know the ratio of the length of the connecting-rod to the radius of the crank circle, and assuming that for the case under consideration the value of this ratio is 5 to 1, or "five cranks," we follow the 24,000 pound piston load line until it crosses the radial line marked 5 cranks; from this point of intersection, move across the chart to the left to the radial line of allowable crosshead bearing surface pressure. Assuming that the value used is 40 pounds per square inch, we follow up the vertical line to *EF* at the top of the chart, and find that 123 square inches is the proper area for the crosshead bearing surface.

The total load on the crosshead guide is represented on line *BF* at the right-hand margin of the chart, and is found by moving across the chart to the right from the point of intersection of the piston load line and the radial line representing the ratio of connecting length to crank radius.

* * *

None of us today really believe that men are created equal, but we do believe that they are entitled to an equal opportunity. Moreover, developments seem to indicate that the more nearly we can accord men equal opportunities for advancement, the more prosperous will be the individual and the country as a whole.—*H. L. Gantt, in Industrial Leadership.*

* Address: 1308 Franklin Ave., Bond Hill, Cincinnati, Ohio.

ALBERT BALL'S MAGAZINE RIFLE OF 1863

A CHAPTER ON MACHINE TOOL DEVELOPMENT AND RIFLE MANUFACTURE

BY GUY HUBBARD*

THE machine tool business in the United States is unusually prosperous at present, due to the impetus it has received, both directly and indirectly, by the European war. The direct result of the war is shown in the boom in the manufacture of munitions, while the great increase in the production of machine tools, which are required in quantities by the munition makers in this country and abroad, may be called the indirect result. The conditions at present existing in these lines are considered unparalleled, and in certain particulars they are, but in many respects the same conditions existed in the North, especially in the New England states, during the Civil War. At that time the war was upon home ground, and production was hastened by a general desire for self-preservation and perhaps by patriotic motives; yet in those days, as now, fortunes were made in the mechanical industries. The town of Windsor, Vt., furnishes in its machine tool industry of today and that of fifty years or more ago a comparison of these two periods, and it is with the earlier of these that this article is mainly concerned.

Some years prior to the Civil War a gun shop was started at a point where the water power was abundant and about which Windsor, like many other New England towns, grew up. The organization of this gun shop gradually brought together a considerable company of skilled workmen, among whom were certain men having more than the usual amount of inventive genius. Through the efforts of these men the products of the concern became widely and favorably known at a time when more than a local reputation was rare. The extent of the reputation is shown by the fact that the Windsor rifle was a favorite among Kentucky hunters and it also armed the soldiers of Texas at the time when, as the "Lone Star Republic," she fought the whole of Mexico.

A famous product of the old concern was known as the "100-to-the-pound" rifle, the small-bore gun of its day and a general favorite among sportsmen and pioneers in the '30s. This rifle had a barrel of extraordinary length and shot a round bullet, one hundred of which weighed a pound, making it 0.36 inch caliber. A short man must have had some difficulty in ramming a charge into the long barrel, but it utilized the expansive energy of the powder to such a high degree that a light charge served to drive the bullet at high velocity, as the space for acceleration was great.

A system of rifling called the increased twist was applied to the rifle mentioned, this system being afterward discarded by gunsmiths as being a needless refinement. The greatest care was taken in the manufacture of the barrels for these rifles, and before they were passed by the inspector, each one was held toward a window in order to determine by the distortion of the reflection in the polished interior whether the barrel was suitable for use or not. The writer has heard it stated that "Dave" Crockett was carrying one of these particular rifles when the coon came down, but does not wish to vouch for the truth of this. In these early days of gun manufacture, a great deal of the work was hand work, or, at the least, work which was partially done by hand, as, for example, chipping and filing, and the turning of metals in slow-running speed lathes with hand tools, while threads were frequently cut by hand chasing, the accuracy depending upon the skill of the workman in the initial guiding of the chaser along the rest. It was not long, however, before this gun shop began to design and build machines to do its work, many of these machines being of novel design which afterward proved very successful. By good authority, credit is given to these designers for the introduction of the shaper or crank planer (as it was then called), milling machines and profilers, disk grinder, and most important of all, the turret lathe. So successful was their machinery that other armories and machine shops both here and abroad began to buy it. For example, when the well-known firm of Enfield in England began to manufacture rifles, the entire outfit of machinery was built at Windsor, Vt.

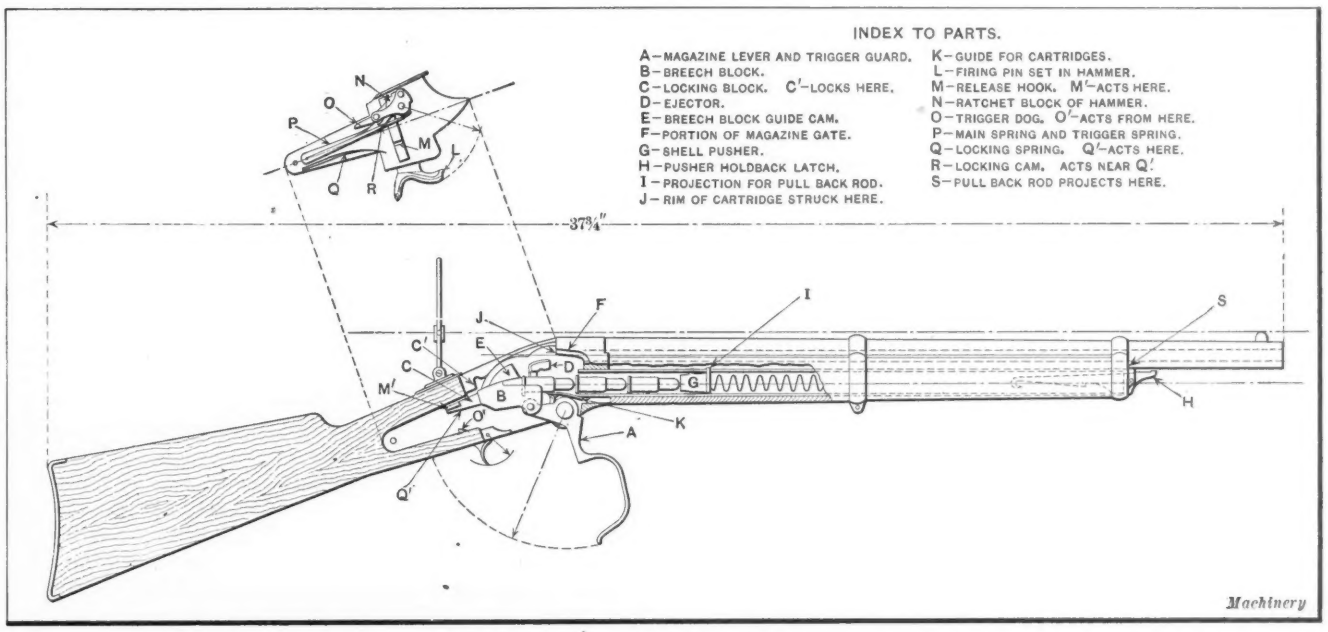


Fig. 1. Diagram showing Mechanism of Ball's Magazine Rifle

Thus it was that parallel to the gun business there grew up at Windsor a machine tool business which was destined to outlive its parallel and to come down to our own time as a leader in the field opened by the introduction of the turret lathe. The original Windsor concern was the root from which grew an extraordinary network of newer machine companies, some of which are now among the largest and best known in the United States. The influence of the industry at this point has been very thoroughly investigated by Prof. Roe of the Sheffield Scientific School.

The name by which one of the factories was known at that time was Robbins & Lawrence. Many inventions were made and developed by this concern, one of which was a five-shot pistol, patented in 1849. A description of this pistol was published in MACHINERY, May, 1912. At about this time Robbins & Lawrence built the Windsor Armory which was a large brick

* Address: Windsor, Vt.

structure; this is still in a fine state of preservation and is now used as a power station, where the first "Stumpf Uniflow" engine to be installed in New England is in operation. While the armory was still under construction large contracts for army muskets were received from the United States government, with the result that the new shop became a very busy place. These muskets were smooth-bore guns of large caliber not unlike cylinder bored shot guns, though having heavy barrels designed to shoot solid balls, and one phase of their manufacture that may be of interest was the making of the barrels.

A musket barrel was made at that time of flat stock, somewhat thicker than the walls of the finished gun, this stock being forged up about a rod and its edges welded lengthwise along the barrel, just as old-fashioned wrought iron pipe was made. It is apparent that this weld needed to be perfect or the gun would tear open when fired; there were few men in the country who were expert enough to be trusted on this work, and there was just one man with this company who could do it. For this reason this particular workman received the then unheard of wages of $10 per day. He was also experienced in making the so-called "stub and twist" barrels used on the superfine sporting and target guns made up on special orders. The stock for these barrels was forged in a narrow strip from high-grade scrap (horse-shoe nails in particular), then wound spirally about a rod and the edges welded. When finished, these barrels presented a handsome mottled appearance, and because of the direction of the fibers were unlikely to burst.

A short time previous to the outbreak of the Civil War, Robbins & Lawrence became associated with a concern making the Sharpe rifle. This company met with business reverses of such magnitude that both concerns failed completely, which was a rather common occurrence at that critical period. When the Windsor Armory with its full equipment and power was put up for sale, E. G. Lamson of the Lamson & Goodnow Cutlery Co. purchased the entire outfit at a ridiculously low figure, the price that he paid for the machinery being its scrap value only. At this time the Civil War broke out and Mr. Lamson immediately discovered that he had purchased a veritable gold mine, for not only did he own a plant in readiness to manufacture the guns for which there was a prodigious demand, but he possessed also an excess of gun making machinery. From this excess machinery he cleared $83,000 in one year, which was more than the initial cost of the whole plant. $10,000 of this was realized from the bayonet room alone. He also set the armory in operation after having received heavy orders from the government, and after gas was installed for lighting, ran night and day shifts, employing nearly five hundred men.

At this time the standard army gun was being manufactured at a large profit, $17 apiece being paid for them in quantity; yet Mr. Lamson looked about for something better than the muzzle loading gun. This possibly incited Alfred Ball, a young mechanic in Mr. Lamson's employ, to bring forward his magazine rifle, which, viewed from a modern standpoint and in the light of future developments, was plainly an invention far ahead of its time. Mr. Ball obtained basic patents on his gun in 1863, the third year of the war, and steps were immediately taken by Mr. Lamson to manufacture it on a large scale.

The construction of this rifle is shown in Fig. 1. Primarily it is a lever-action, breech-loading repeating rifle, using metallic cartridges carried in a tubular magazine beneath the barrel, and resembling quite closely the present-day repeating rifle in many of its features. It must be remembered that at this time the ready-made brass shell, the magazine principle of handling the shell, and the breech method of loading were all innovations, so that there were three improvements of prime importance in the Ball rifle. These guns were made in two types, one a heavy infantry rifle, 0.50 inch caliber, and the other a short and comparatively light rifled carbine, 0.38 inch caliber, designed for cavalry service. This latter model, while it was never put on the market, was preferred, I understand, by the designer. It was the good fortune of the writer to be able to borrow from Mr. Gridley one of the carbines, although specimens of both models are now somewhat rare; the following description is therefore confined to this type, the essential principles being identical in both models.

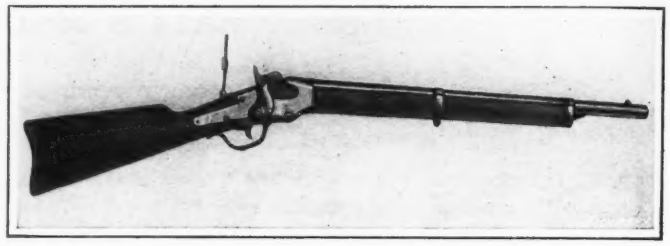


Fig. 2. Ball's Magazine Rifle assembled

The Ball carbine shown in the illustrations accompanying this article has an over-all length of 37¾ inches and weighs 8 pounds. Nine of the rather chunky rim-fire cartridges may be carried in the magazine, which consists of a brass tube 16 inches long and ¾ inch in diameter, located below the barrel. This tube contains a pusher *G* to feed the shells, the pressure being exerted by a long coiled spring of steel wire. The spring was made from No. 22 wire (Birmingham gage used at that time), and when free is 28 inches in length, but compresses on full magazine into a space of 3 inches, so that considerable force is exerted in the range of movement of the pusher. In order to facilitate the loading of the magazine a pull-back rod projects like a ram rod beside the barrel and engages a projection on the pusher. This works in an L-shaped track soldered over a slot in the magazine, the pusher projection *I* traveling in this slot. When the pusher is drawn back, it is caught by a latch *H* at the end of the magazine and held so that the rod may be pushed in out of the way, and after the magazine is loaded the pusher is released by pressure on this latch. The brass rim-fire shells used in the Ball rifle were among the first prepared cartridges of the type now in use. They were similar to those used in the old Smith & Wesson 0.38 inch caliber revolver, and the writer believes the original cartridges were made by this company. Upon experiment it was found that dry ammunition gave trouble in the gun, so Mr. Ball designed a cartridge greasing machine which is used today in all cartridge factories, and this overcame the difficulty. The shells were loaded with 20 grains of black rifle powder and a round nose lead bullet of 150 grains, this combination having considerable stopping power at moderate ranges. The primer was composed of fulminate of mercury spun out into the rim of the shell.

The barrel of the carbine tapers from 1 to ¾ inch at the muzzle, making it amply heavy at the breech. It is bored to 0.38 inch caliber and has five grooves broached through it, these grooves having a uniform lead of 30 inches to the helix. The barrel was made from a steel forging and the breech frame was shrunk onto it. This frame is a drop-forging of intricate pattern, its interior being milled out to contain and guide the loading mechanism, and its wearing surfaces bushed with hardened tool steel. The wooden parts, stock and magazine cover are of black walnut and were turned to shape in a gun stock lathe; the recesses in them were cut by fast running end-mills or burrs. Fig. 2 shows the general appearance of

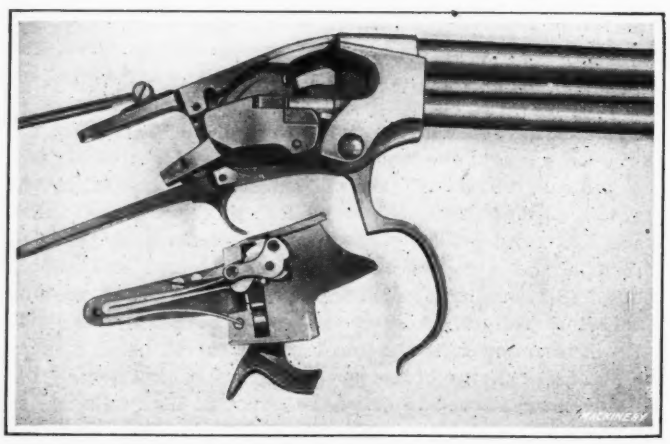


Fig. 3. Action of Ball's Rifle at End of Operation 1

Fig. 4. Action of Ball's Rifle at Beginning of Operation 5

the assembled Ball carbine. In order to indicate as clearly as possible the internal mechanism of the gun, the sectional assembly drawing shown at the upper left-hand portion of Fig. 1 is revolved upward through an angle of 180 degrees, so that the projection shows it bottom side up and inside out in order to show its position in relation to the loading mechanism. In order to explain the working of the Ball gun, the process for a complete cycle of operations is indicated herewith, reference being made to the illustrations accompanying the article.

Details of Rifle Manipulation

1. Gun empty, full cock, and magazine open. Pull back magazine spring by rod projecting at end of magazine (not shown) until pusher is caught by latch. Then push rod back, drop cartridges into magazine through gate, bullets facing front. When full, release spring by pressing latch, which causes first shell to be pushed out of magazine, whence it is guided by the trough into the breech-block, where it is held in place by the forward and downward pressure of the ejector upon it. See Fig. 3.

2. Magazine lever is started upward. Front end of breech-block begins to swing upward, being pivoted to short arm of magazine lever, while rear end is guided upward and forward by flat cam on frame. Ejector forced back by pressure of shell against curved arm; locking block pushed upward against frame by flat spring on lock plate. Guide trough pivoted to under side of short arm of magazine lever, tips up, holds back second shell, and slides beneath mouth of magazine.

3. Movement of magazine lever is completed. Ejector is pushed completely back and nose of bullet enters chamber of barrel. Locking block drops into place behind shoulder and is held in place by spring, thus locking breech. Breech-block is now part of chamber and covers magazine gate. Shell is locked on chamber with small part of rim exposed to blow from firing pin on edge of hammer face.

4. Trigger is pulled. Heel of trigger bears upward against long lever arm on pivoted dog on lock plate. Edge of short arm of dog slips out of notch in ratchet block integral with hammer, and ratchet block is revolved about 30 degrees by opening of double flat spring connected to it off center by link. This causes hammer to fall, exploding cartridge, while at the same time locking cam fastened to ratchet block is thrown up beneath locking block, causing positive locking of breech at instant of explosion. Release hook on breech spring slide, operated by turning of ratchet block, also snaps above locking block. Fig. 4 shows position of receiver mechanism at this stage in cycle.

5. Gun is cocked. Ratchet block turns back and edge of dog drops into notches, first that for half cocking, then that for full cocking, where it is held. At the same time locking cam is withdrawn and release hook pulled down locking block, unlocking loading mechanism.

6. Magazine lever is thrown down. As breech-block recedes, shell is withdrawn from chamber and magazine gate opens. Ejector suddenly slips off corner of breech-block and snaps empty shell out through gate. As breech-block comes back to starting point, guide trough is drawn into place and second shell moves into position. This completes the cycle.

Although this cycle of operations takes some time to describe, it is quickly done, and the gun may be fired as fast as the lever can be worked and the trigger pulled, the 0.50 inch caliber barrel sometimes becoming too hot to hold, while the effect upon the shoulder of the operator is like the pound of a pneumatic hammer. The action of the Ball gun must also have been somewhat disconcerting to the men at the other end who were armed with single-shot muzzle loaders at this time. When it was desired, this rifle could be used as a single-shot breech loader, by inserting the magazine cut-off, a pin set across the mouth of the magazine to hold back the shells, and putting the cartridges directly into the breech-block.

After tests had been carried out upon the Ball gun and its practicability as a service arm demonstrated, the Federal government became interested and preparations for its manufacture in quantities were hastened. The tests as conducted by government officials stationed at the armory were, to say the least, somewhat rigorous, the test of barrels in particular being very severe. Before the guns were assembled, a long row of barrels, loaded with double charges of powder and balls, was set in a rack in a sort of "bomb-proof" room, the muzzles directed toward a sand bank. All the charges were then fired at once by a train of powder touched off from outside, the resulting roar being heard all over the town. The barrels which survived this test were again tested by regular loads to reveal any weaknesses developed by the first trial. The inside of the bomb-proof room was well studded with pieces of burst barrels after many of these tests had been made.

A further test was occasionally given by selecting a sample from among the finished guns, this being buried in a mixture of salt, iron-chips and wet earth, to be exhumed later and tested to determine whether it was still in working order. In those days an ordinary gun consisted of "lock, stock and barrel," so that it is not surprising that experts were rather skeptical in regard to the complicated Ball repeater. As the interchangeable system of manufacture was in force at this time at the Windsor Armory, a great deal of special machinery, as well as expensive jigs and fixtures, was required before the new rifle could be made in any numbers. All these operations required both time and money, and when all was in readiness, $25,000 had been spent on special machinery and the year 1864 was nearly over. A contract was made with the Federal government as indicated by the nameplate on the gun. The wording on this plate reads: "E. G. Lamson & Co., Windsor, Vt., U. S., Ball's Patent, June 23, 1863."

Some of the special machines that were built for this rifle were deep drilling machines for boring barrels, rifling machines, drop-forging hammers and dies, gun stock lathes, and profile milling machines. It is known that some of these rifling machines are still in service at the factory of a well-known maker of revolvers. The output of the armory was sufficiently great so that the Ball rifle might easily have proved to be a deciding factor in favor of the North, and, in fact, hundreds of these repeating rifles had already been made and they were just coming into use when the war came to an end. Thus it was that the whole thing went flat at this time and no more guns were wanted. Hence, cases of modern magazine rifles sold at ½ cent per pound, and many a Vermont

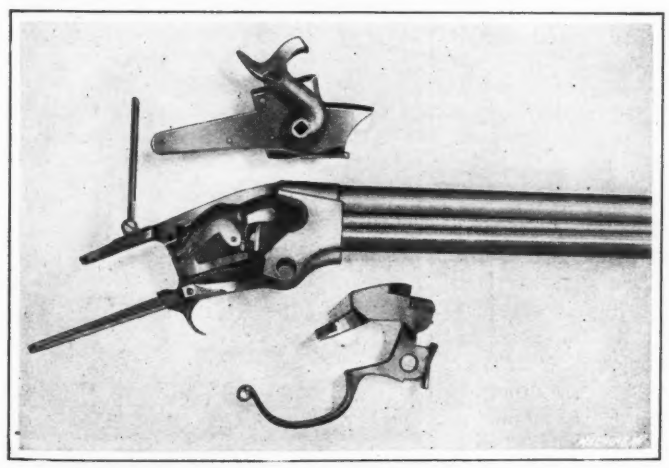


Fig. 5. Loading Mechanism of Ball's Rifle partly disassembled

hunter in the late '60s carried a gun like those in use by the hunters of the present generation. At the same time hunters in other sections of the country were still using "muzzle loaders" with the powder, ball, and percussion caps.

It now remained for Prussia with her "needle gun" to demonstrate in 1866 and 1871 what could be accomplished by the use of single-shot breech-loading rifles in warfare. The Ball repeater as an invention lay dormant for many years, but finally came to the front again as the Winchester repeater, and as such has a wide reputation. After the crash, the special gun making machinery all went into storage and finally was sold as junk, marking the end of the munition business at Windsor, Vt. The machine tool industry, however, did not die out in 1865, but after passing through many precarious years as the old Windsor Machine Co., the idea of the turret lathe bore fruit, and the concern now flourishes in a large and growing modern plant as the manufacturer of the "Gridley" automatic screw machine. The munition idea still persists in the minds of some people who recollect the past, and only a short time ago an old gentleman who was being shown through the shop looked over a single-spindle "Gridley" automatic and inquired which end of the spindle the shot was fired from, while another person asked, in regard to the multiple-spindle machine, how the four-barrel cannon was moved about on the field of battle.

Albert Ball, who invented the magazine rifle, has reached

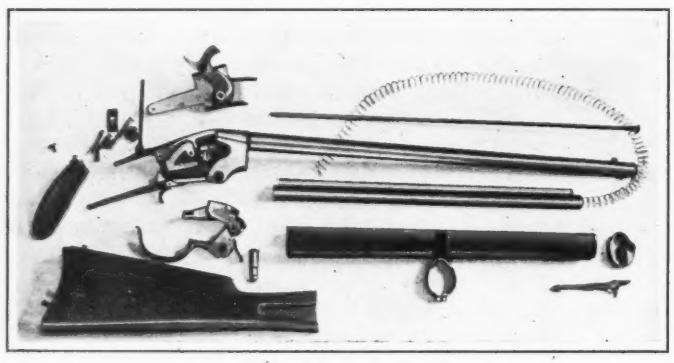


Fig. 6. Details of Ball's Rifle

nearly the allotted "four score years and ten," and is still an active designer with the Sullivan Machine Co., at Claremont, N. H., and has been for many years the mechanical engineer of this concern. In addition to the magazine rifle, Mr. Ball has to his credit numerous important inventions in mining machinery, steam engines, air compressors, and allied machines. There is little doubt that he is one of the last of the Civil War period inventors worthy of note, and has more than held his own beside those of another generation. He is a living example of the truth of a statement made by an old-time designer of machinery: "We of those days" (this man said, in reference to mechanics of years gone by) "were just as intelligent as you of to-day. We had little behind us, and built up, step by step, those things upon which you have learned unconsciously to depend. Without the foundation laid by us you could not build the intricate machines of the present day, but would yourselves be forced to lay foundations instead of building upon them."

The writer is indebted for much of the material contained in this article to G. W. Hubbard, who was a draftsman at the armory in 1853; G. O. Gridley of the National-Acme Mfg. Co., inventor of the "Gridley" automatic screw machine; Mack Mower, Frank Hall and M. Harrington, who have been connected with the Windsor shops for many years.

* * *

EXTENSION MILLING ATTACHMENT

There are two bearing bosses used to confine the reverse idler shaft in the transmission case of the Maxwell automobile which are so situated on the interior of the case that it is difficult to machine them quickly and accurately. This was one of the problems confronting the manufacturing department of the Maxwell Motor Co., New Castle, Ind., and after trying a double facing tool in a drill press and, later, end-milling, the milling fixture and extension milling attachment shown in Figs. 1 and 2 were designed.

The milling fixture is of simple construction, consisting of two fixed locating plugs on one end and a movable locating plug on the other end which is run in and out by a handwheel and screw. The extension milling attachment consists of a rigid casting which is attached to the column of the milling machine by screws. On an extended portion of this casting, and so situated as to be able to reach into the transmission case a sufficient distance, are located two side mills which are driven by a train of gears from the main driving spindle of the milling machine. The distance between the bosses in the transmission case which is to be milled is 1 15/16 inch, and the two side mills are placed just this distance apart, so that it is only necessary to run the mills between the two bosses to accomplish the operation.

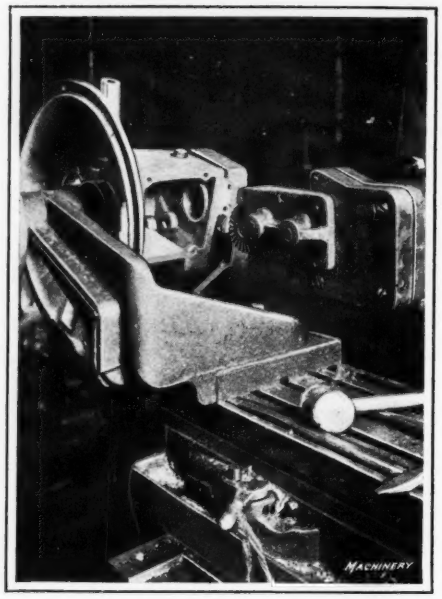


Fig. 1. Extension Milling Attachment, with Work in Place in Fixture

With the previous methods of milling, it was impossible to machine any two bosses exactly alike, and the best production was 125 cases in ten hours. By the use of this milling attachment and fixture, it is possible to mill any number with an error not exceeding 0.003 inch, and with a production of 250 cases per day with one machine and one operator.

It is apparent that this fixture paid for itself very soon, and the greater degree of accuracy secured through its use was, of course, an advantage. The attachment is shown being used on a No. 1½ Cincinnati milling machine. V. B.

* * *

NON-CLIMBABLE FENCES

Two knights of the road of the yeggmen type sauntered by a munitions plant surrounded by a high woven wire fence. The fence was surmounted by three strands of vicious barbed wire set to overhang each side. The makers sign, "Hicks Non-climbable Fence," roused the slimmer yeggman's ire.

"Say, dat fella *is* a 'hick'—his fence is easy. If I wants to get in, do you know what, bo? I gets a few burlap bags and makes me a cushion, see, to trow over de hooks so, and over I goes slick and easy. When I makes me getaway de cushion is de Johnny again. Dese fellas dat tink dey can keep tings under lock and key makes me tired."

From which we learn that barriers are not as effectual to the ingenious as they appear to simple, law-abiding souls to whom a Yale lock or "No Admittance" means "keep out."

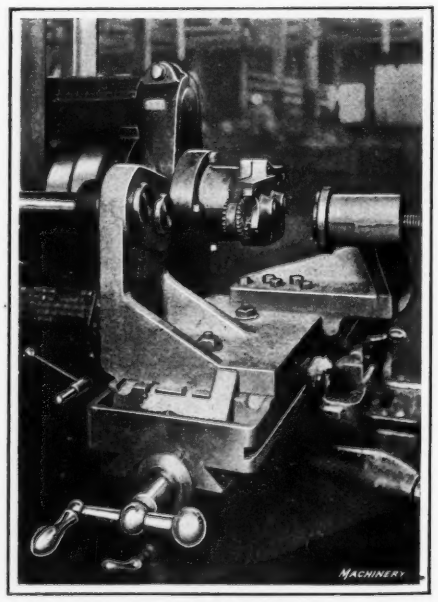


Fig. 2. Fixture shown Empty, with Locating Plugs exposed

RECENT LEGAL DECISIONS INVOLVING MACHINERY

State Regulation of Sales

(Virginia) The Supreme Court of Virginia recently handed down an opinion holding that the business of a foreign corporation in bringing its machines into the state before selling them, in maintaining a stock of machines for exhibition and trial and selling them after their transportation in interstate commerce has ended and they have become mingled with the general mass of property in the state, in renting such machines and collecting rents therefor, in buying and exchanging machines for those of other make, and selling the machines received in exchange at will, in employing a mechanic in the state and entering into yearly contracts for repairing machines, and in keeping on hand in the state parts of machines which are frequently sold in the state, constitute intrastate commerce, in the transaction of which the company is subject to state regulation.

The Dalton Machine Co. was fined $1000 for having failed to pay the state corporation license tax. The company's defense was that it was not subject to regulation by the state, as it was engaged only in interstate commerce. The evidence established the fact that the defendant, though engaged in the interstate sale of machines, maintained a salesroom and sales agency in Virginia, employed salesmen, clerks, and repairmen whose duty was performed wholly within the state of Virginia. In holding the company subject to the license tax on the ground that it was engaged in intrastate commerce, the court said:

> Nobody may, by any device or by any ways or means whatsoever, avoid local license taxes for doing intrastate business contrary to the laws of this state. That this method of transacting business by the Dalton Machine Co. is a mere device for the purpose of avoiding the state statutes is apparent when the contention is made that, even in case of a cash transaction, when a machine previously in the possession of the purchaser is sold by a local agent to that purchaser for cash, strictly in accordance with the previous instructions given to the local agent, such a transaction needs confirmation by the company at its home office. The price is fixed, the property delivered, the terms complied with, and nothing is left of such a transaction except for the local agent to send the check or the currency to the selling company. Inasmuch as the purchaser has complied with every substantial term of the contract, it is not believed that the selling company could refuse to accept the purchase price, notwithstanding the device referred to. It can only be resorted to in case of such a cash transaction for the purpose of attempting to convert "into a form resembling interstate commerce that which in its intrinsic substance is local business subject to state control. We think it perfectly apparent that in these particulars the business of the company in this state is not "commerce among the states," the freedom of which is guaranteed by the United States Constitution, but that such business, in every essential particular, is business which has been transacted by the company in this state in violation of the statutes referred to. *(Dalton Machine Co. v. Commonwealth, 88 S. E. 170.)*

Only Reasonably Safe Appliances can be Required

(Pennsylvania) In an action for injuries to a servant while unloading freight from cars, where the negligence alleged was the failure to supply appliances for unloading the cars instead of iron straps for sliding the freight to the ground, but it did not appear that the method employed was dangerous or unusual, though that suggested might have been safer, it was an error to submit the case to the jury, and a verdict should have been directed for defendant.

The Pennsylvania Supreme Court came to the foregoing conclusion in Miller v. Republic Chemical Co. The Republic Chemical Co. owns and operates a plant for the manufacture of chemicals. In the course of the construction and operation of its plant, it received from time to time, on board cars, certain heavy pieces of machinery, varying in weight from one to two tons each. This machinery was generally skidded from the car into the building, though it was a known fact that it could have been handled better had it been moved with a crane. Plaintiff was injured while unloading some such machinery. He brought this suit basing his case on the theory that defendant had not used the most practical method in unloading the machinery; that had a crane been provided for use, no injury would have occurred.

The Supreme Court, in reviewing the case, reversed a judgment of the trial court in favor of plaintiff. In its opinion the court said, in part:

> The plaintiff admits that as an employe of the defendant he had been engaged in exactly the same work, using the same device, for a period of six months prior to the accident complained of. He mentions not a single mishap during this period.
>
> What duty owing to the plaintiff in the choice of method did the defendant neglect to observe? When the employer furnishes his employe the tools and appliances which, though not the best possible, may by ordinary care be used without danger, he has discharged his duty, and is not responsible for accidents.
>
> If the machinery be of an ordinary character, and such as can, with reasonable care, be used without danger to the employe, it is all that can be required from the employer—this is the limit of his responsibility, and the sum total of his duty.

Even were it admitted that the evidence was sufficient to warrant the conclusion that the crane method was the safer, it comes far short of showing a disregard of any duty on the part of the defendant in not adopting it. A plaintiff can only prove negligence in such case as this by showing that the appliance used was not reasonably safe. Even though it be made to appear that it was not in ordinary use, such fact would not warrant an inference of negligence. *(Miller v. Republic Chemical Co., 97 A. 73.)*

Operation of Machinery

(Pennsylvania) An employe cannot recover for personal injuries sustained in stopping machinery by grasping a flywheel, thereby bringing his hands into contact with a bracket which had just been put into place, intended to hold a guard, of which the employe knew, when there were several other wheels by which he might have stopped the machinery more safely. *(Hoffman v. Brentmore Knitting Mills, 97 A. 474.)*

Proper Protection Must be Provided

(Federal) Plaintiff, a machinist's helper, was holding by an iron bar a journal from turning on the axle, while the machinist was chipping therefrom with a chisel and hammer. On the machinist's order, he laid down the bar, helped to turn the box over, and without any further direction stooped down to pick up the bar. While doing so the machinist resumed chipping on the box, and a chip struck plaintiff's eye. There was no protection from the chips, nor warning that the machinist was about to resume chipping. There was evidence that chipping such boxes was particularly dangerous to bystanders, and that it was a good practice, and the general practice in that shop, to provide some barrier, such as a canvas, board, box or broom. Held, the plaintiff is entitled to recover for the employer's negligence in failing to supply protection from the chips. *(Siegesmund v. Chicago, M. & St. P. Ry. Co., 229 Fed. 956.)*

* * *

Bortz are obtainable in various sizes and qualities. For truing wheels up to 24 by 2 inches, the one carat stone answers very well and probably gives as much yield per dollar invested as larger stones of the same quality. When, however, wheels over 2 inches wide are to be trued, it has been our experience that the larger stones give greater service. This is doubtless due to the fact that the longer the contact of the diamond and wheel, the greater the heat generated. A copious supply of water should always be directed on the diamond during truing operations to carry away the heat generated. For truing wheels over 2 inches and up to 6 or 8 inches wide the advantage of using the larger stones is that they offer a greater mass to dissipate the heat, and as a result do not break down so quickly. The difficulty, however, is to secure stones of two or three carat size of the light brown variety which will be free from fractures or flaws. Perfect stones are more easily obtained in sizes ranging from ½ to 1½ carat. It has therefore been our practice for the general run of grinding to select stones weighing approximately one carat.—*Grits and Grinds.*

BOARD DROP-HAMMERS

GENERAL CONSTRUCTION, OPERATION AND DESIGN OF IMPORTANT DETAILS OF DROP-HAMMERS BUILT BY WELL-KNOWN MANUFACTURERS

BY DIXIE

BOARD drop-hammers have been in practical use a little over sixty years for the production of drop-forgings, and owe their present high state of development to American designers. The crank drop-hammer or "Peck lift" was also largely used for drop-forging in the early days of the industry, but this type is now confined largely to stamping work and the silverware trade. The first patent containing the basic principle of the board drop-hammer was taken out by Goulding & Cheney in 1861, the patent covering a drop-hammer that was lifted by means of a belt or board placed between rolls running in opposite directions. Practical working drop-hammers were used as early as 1853, and they have since been built in two types. One is known as the board clamp type, the hammer being held at the top of its stroke by clamps or toggles gripping the board. The other is the latch or catch-up type which is now seldom used. With this construction, the hammer had a recess milled into one side to receive a latch or finger that was pivoted adjustably to one of the uprights and connected to the foot-treadle. As the hammer reached the top of its stroke, the latch dropped into the recess and held the hammer up. All modern board drop-hammers of whatever make are but a modification or combination of the early designs with certain changes which were needed to meet the severe service of modern requirements.

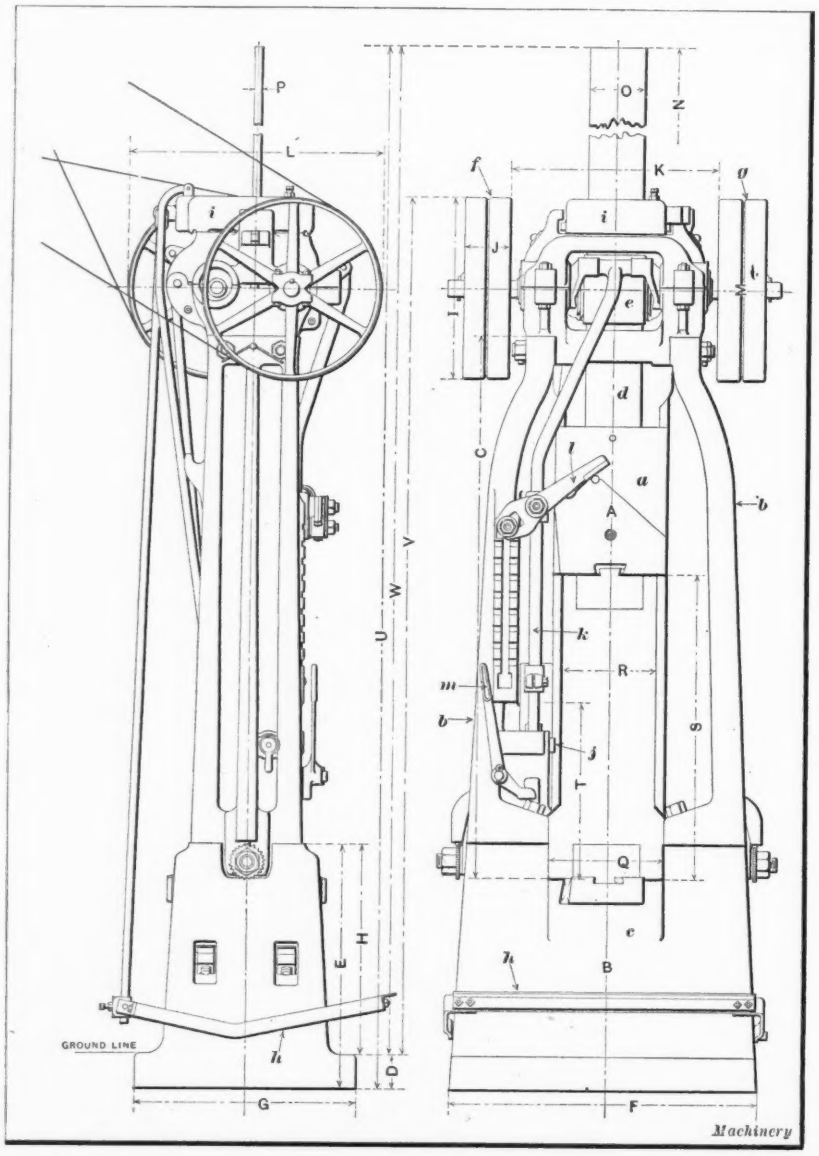


Fig. 1. Side and Front Elevations of a Billings & Spencer Board Drop-hammer—Dimensions given in Table on Opposite Page

General Construction of Board Drop-hammers

The board drop-hammer is so named because the hammer proper is raised by the action of friction rolls which bear against a board that is attached to the hammer. The design shown in Fig. 1 will serve to illustrate the most important constructional features and the principle governing the operation of drop-hammers generally. The hammer *a* to which the upper die is attached operates between two uprights *b*, and is held in position by V-shaped guides. These uprights are attached to the base *c*, which carries the lower die. A board *d* is attached to the hammer head *a*, and extends upward, passing between front and rear friction rolls at *e*. These rolls are revolved in opposite directions by open and crossed belts operating on pulleys *f* and *g*. One pulley drives the front roll and the other the rear roll.

The action of the hammer is controlled by a foot-treadle *h*, which is connected with board clamps enclosed at *i*. There are two of these clamps, one at the front and the other at the rear of the board, and they serve to hold the hammer in its upper position when the foot-treadle is released. When the foot-treadle is depressed, these board clamps are withdrawn, thus releasing the board and allowing the hammer to drop; the front elevating friction roll at *e* is previously withdrawn slightly, so that the hammer falls freely.

As the hammer approaches the bottom of its stroke an incline surface on the side engages a plunger or knock-off *j* which is forced back, thus allowing the friction bar or front rod *k* to drop. This downward movement of the friction bar *k* moves the eccentrically mounted friction roll *e* against the board so that the hammer is immediately elevated preparatory to making another stroke. As the hammer approaches the top of its stroke, a pin attached to the hammer comes into contact with the roll-releasing lever *l*, which raises the friction bar *k*, thus withdrawing the front friction roll from contact with the board and stopping further upward movement. As soon as the pressure of the friction driving roll is released the hammer will again fall and will continue to run automatically as long as the foot-treadle is held downward. When this treadle is released the board clamps at *i* grip the board as soon as it reaches the top of its stroke and start to move downward.

By more or less depression of the treadle, variation in the force of the blow may be obtained, regardless of the stroke or fall for which the hammer is adjusted. For instance, when the foot-treadle is pushed all the way down, the clamps are entirely released and the hammer drops freely, whereas if the treadle is only partly depressed there is more or less friction between the board and the clamp, and the fall of the hammer is retarded correspondingly. The hammer can also be stopped at any point when falling, without injury to the working part.

The stroke of the hammer, or the height to which it ascends before falling, is regulated by changing the vertical position of the roll-releasing lever *l*. Means are also provided for adjusting the friction-bar releasing mechanism at *j*, in accordance

with the thickness of the dies used. Thus, when using thick dies, the trip mechanism is set so that the friction bar *k* will drop sooner, thus causing the friction rolls to lift the hammer sooner. A lever *m* is provided for raising the friction bar by hand when necessary. The board *d* should preferably be of seasoned maple, as this has been found to give better service than any other kind of wood. Paper fiber has been tried with fairly good results, but as yet the cost of this material is prohibitive.

While all board drop-hammers operate on the same general principle as the one described in the foregoing, the details of the different designs vary considerably, and therefore the more important features embodied in the design of well-known makes of drop-hammers will be described and illustrated in detail.

Cross Adjustment for Alignment of Dies

With one or two exceptions, the builders of steam drop-hammers make no provision for cross adjustment of the dies, justing screw *B* bears against the upright, there is generally a tool steel plug inserted to prevent battering the upright.

To adjust the dies for alignment, first lower the hammer or ram until the faces of the dies are together; then loosen the upright base bolts *F* and the lock-nuts *G* on the adjusting screws and back off one screw in the direction toward which it is desired to move the top die, tightening the opposite screw a corresponding amount. The hammer or ram, acting as a distance piece between the guides, will move the entire superstructure. In locking the adjusting screws, care must be taken not to pinch the hammer between the guides. The uprights are kept in line by two guides *C* just outside the lug. In this construction, as well as in the design shown in Fig. 3, the upright base bolts are vertical and cushioned by leather washers *H* under the nuts. The bolt holes are cored, and they are elongated in the base to allow for a limited cross adjustment. It is essential that these bolts be kept tight or the

GENERAL DIMENSIONS OF A DROP-HAMMER—BILLINGS & SPENCER CO., MODEL D

Weight of Hammer	Weight of Base	Length of Uprights, Feet and Inches	Below the Ground Line, Inches	Height of Base, Inches	Length of Base, Inches	Width of Base, Inches	Above the Ground Line, Inches	Diam. of Pulleys, Inches	Face of Pulleys, Inches	Between Pulleys, Inches	Pulley Space, Inches	Revolutions Per Min.
A	B	C	D	E	F	G	H	I	J	K	L	M
400	6000	6-6	3½	41	42	27	37½	26	6	28	37	190
500	7500	6-6	3½	41	42	27	37½	26	6	28	37	190
600	9000	7	3½	41¼	49½	30	37¾	30	7	32	41	170
800	12000	7	10	47⅝	49½	30	37⅝	30	7	32	41	170
1000	15000	8	7½	43¾	57¾	40	36¼	32	8	38	45	130
1200	18000	8	12⅝	48⅞	58¼	40	36¼	36	8	38	49	115
1400	21000	8	17⅞	54⅛	58⅞	40	36¼	36	8	38	49	115
1600	24000	8	21	57¼	59¼	40	36¼	42	8	38	55	110
1800	27000	8-6	18½	52¾	65½	39½	34¼	48	9	43	61	105
2000	30000	8-6	23	57¼	65⅞	40	34¼	48	9	43	61	105
2500	37500	9-6	21½	56½	71	47	35	56	10	55	69	100
3000	45000	9-6	22¼	57¼	71	48	35	56	10	55	69	100

Weight of Hammer	Length of Board, Feet and Inches	Width of Board, Inches	Thickness of Board, Inches	Between Uprights Above Base, Inches	Between Ways on Uprights, Inches	Extreme Fall, Feet and Inches	Shortest Automatic Fall, Feet and Inches	Total Height of Machine, Feet and Inches	From Floor to Top of Pulleys, Feet and Inches	Height to Operate Machine, Feet and Inches	Length of Shoe—Front to Rear, Inches	Length of Hammer—Front to Rear, Inches	Horsepower
A	N	O	P	Q	R	S	T	U	V	W			
400	7-7	6	1¼	15	12	4-6	3-0	16-4	11-0	16-1	15½	9	5
500	7-7	6	1¼	15	12	4-4	2-10	16-4	11-0	16-1	15½	9	5
600	8-4	8	1¼	18	14	4-0	2-6	17-1	11-9	16-10	19½	10	5
800	8-4	8	1¼	18	14	3-9	2-3	17-1	11-9	16-10	19½	10	5
1000	8-9	10	1¼	21½	17	4-9	2-6	18-6	12-7	18-0	24	12	10
1200	8-9	10	1¼	21½	17	4-6	2-3	18-6	12-9	18-0	24	14	10
1400	8-9	10	1¼	21½	17	4-6	2-3	19-0	12-9	18-0	24	15	10
1600	8-9	10	1¼	21½	17	4-6	2-3	19-0	13-0	18-0	24	18	10
1800	8-10	12	1¼	25	20	4-0	2-3	19-0	13-9	17-6	27	18	15
2000	8-10	12	1¼	25	20	4-0	2-3	19-6	13-9	17-6	27	18	15
2500	10-5	16	1¼	27½	22	5-0	2-6	21-6	15-2	19-9	30	20	20
3000	10-5	16	1¼	29½	24	5-0	2-6	21-6	15-2	19-9	30	20	20

Machinery

this being done by the use of shims, but the board drop-hammers of all makes have a cross adjustment; the uprights, together with the entire superstructure, are shifted laterally, the bottom die being keyed securely in the base or shoe. Fig. 2 shows the construction used by a number of builders. The anvil shoe *D* is keyed and doweled securely into the base, and the bottom die *E* is keyed to the shoe; both the die and shoe remain stationary so far as cross adjustment is concerned. There is a lug or ear *A* cast integral with the base, through which there is an adjusting screw. In the more modern hammers, this lug is not tapped, but a nut fits into a pocket at the front of the lug. The uprights are cored to clear this lug, and on some drop-hammers the clearance between the top of the lug and the pocket of the upright is great enough to allow the nut to be removed by hand. Where the point of the adblows of the ram will cause a movement of the uprights that will result in excessive wear of the guides. The uprights will also settle into the top of the base, owing to the peening or hammering action, and scale and dirt will enter between the top of the base and the bottom of the upright. To prevent the entrance of dirt, the upright seat is raised above the die seat on at least two well-known designs.

In the design shown in Fig. 3, the lug on the top of the base is dispensed with and an adjusting bracket *A* is hooked into the base, as shown by the front view. This bracket or plate is made thick enough to serve as a guide for the bottom of the upright. The top of the bracket carries the adjusting screw *B*, and there are nuts outside of the upright supported by a projection on the base. A flat plate pressing down a block of wood on top of the body of the adjusting screw

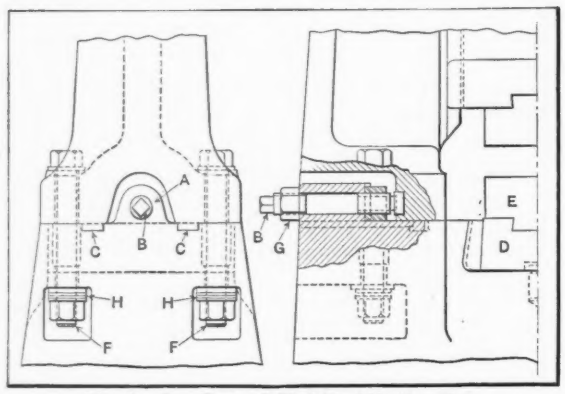


Fig. 2. One Type of Upright Adjusting Bolt

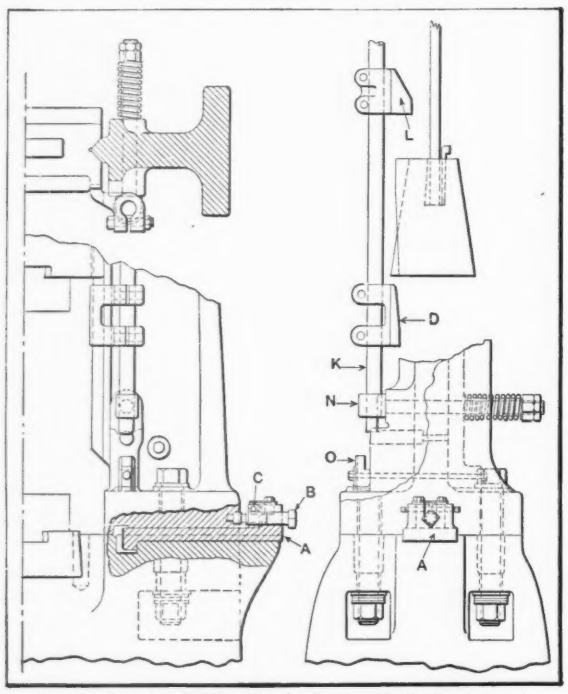


Fig. 3. Front and Side Views, showing Roll-releasing and Tripping Mechanism, and Upright Adjusting Bolt

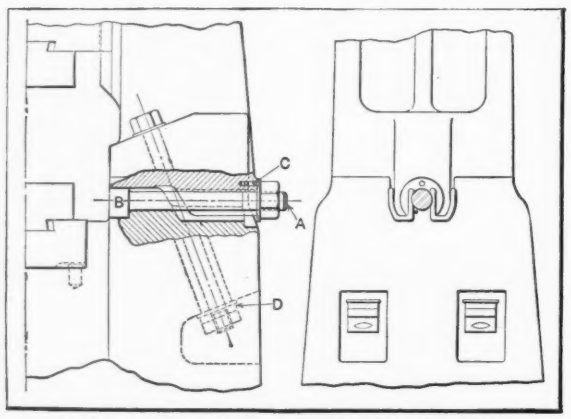


Fig. 4. Another Form of Upright Adjusting Bolt

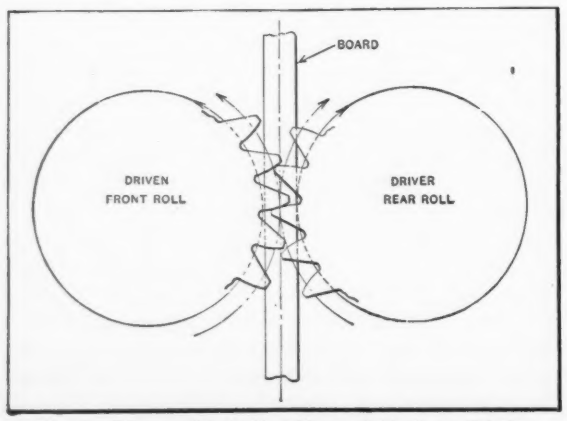


Fig. 5. Diagram illustrating Shape of Teeth on Friction Roll Gears

holds the latter in place. The inserted adjusting nut *C* is split and clamped for a lock-nut. The builder's claim for this construction is that the adjusting nut or screw can be replaced, if necessary, without removing the uprights from the base, which is necessary with the construction shown in Fig. 2 unless the lug is slotted and the upright cored higher. On at least one design, the slotted form of lug is employed.

Cross Adjustment by Bolts in Tension

Fig. 4 shows a method of making cross adjustment by a bolt in tension instead of in compression as in Figs. 2 and 3. The construction is such that in case of failure the old bolt can be replaced with a new one without moving the uprights. The bolt *A* has an eccentric head *B*, the lower portion of which pulls against the base and is resisted by the collar-nut on the outside of the upright. The body of the bolt is held in position by two ribs or supports, one cast on the base and the other on the upright, as shown by the end view. The collar-nut is locked by a horizontal locking pin *C* held out by a spring, and is slotted to receive the beveled point of the locking pin.

The bolts that hold the uprights to the anvil or base are set at approximately 20 degrees from the vertical, thus holding the uprights back against the adjusting collars. Rubber is used as a cushion under the nuts at *D* instead of leather.

It is important to have sufficient bearing surface on the top of the base and the bottom of the upright, as otherwise the weight of the uprights and superstructure will cause the former to "peen down" into the top of the base. In some of the older models of various makes, it is quite common to see the bottom of the uprights peened into the top of the base from 1/8 to 3/16 inch, in from eight to ten years of service.

With the cross adjustment shown in Fig. 6, there is a tension adjusting bolt, but no lugs or ears on either the upright or base. A wide, deep tongue on the bottom of the upright fits into the base for practically its full depth; through this tongue there is a drilled hole to support the body of the adjusting bolt *A*, the head *B* of which is T-shaped and extends across the groove in the base; the collar-nut on the outside of the upright takes all the side thrust. The bolt head is reinforced where it bridges across the guide, to take care of the bending moment. The collar-nut is locked by means of a vertical locking pin *C* and spring. The end of the locking pin is beveled and engages angular notches in the locking collar, thus automatically locking the nut in either direction without the necessity of raising the pin by hand. This construction gives a bearing over the entire top of the base upon which the uprights rest.

By removing the anvil shoe from the base, the frame adjusting bolts can be removed and replaced without raising the uprights. Heavy springs *D* under the nuts cushion the bolts and allow the uprights to be adjusted without loosening the nuts. The cored pocket in the base is of such a shape that in case a bolt fractures, with the long end in the base, it can be removed readily.

Automatic Knock-offs or Bottom Trips

The trip mechanism for automatically throwing the friction rolls into engagement with the board when the hammer is at the bottom of its stroke should be so designed as to take almost any thickness of dies and it should be readily adjustable, so that the rolls can be thrown into engagement with the board as the hammer rebounds from the bottom die. Tripping too soon cushions the blow, because the rolls engage the board and tend to lift the hammer before it strikes its blow. On the other hand, if the knock-off is set too late, the hammer rebounds and falls back before the rolls come into engagement with the board. This means picking up a dead load from rest, which wears the board even more rapidly than tripping too soon. The greatest amount of wear on the board takes place at the point of pick-up or where the rolls first come into engagement with the board.

In general principle, the trip mechanisms of the drop-hammers made by the E. W. Bliss Co., Chambersburg Engineering Co., Waterbury Farrel Foundry & Machine Co., and United Engineering Co. are all the same. The lower face of the hammer (see Figs. 3 and 9) is planed on an incline to correspond to the incline of the knock-off bracket *D*, which is clamped to the lower end of the friction bar *K*. As the hammer descends, the friction bar, which is attached to the front roll eccentric, is pushed off its seat. The falling of the bar throws the rolls into engagement with the board; the weight of the bar is sufficient to hold the rolls against the board with enough friction to lift the hammer to the top of its stroke, where the front roll is released, as will be described later. As the lower end of the friction bar is raised above its seat or shelf by the upward movement of the hammer, a spring-

operated guide *N* pulls the friction bar in on its seat, locking the roll in the release position, ready for another blow. So long as the board clamps are released by depressing the foot-treadle, the hammer will strike continuously.

Adjusting Automatic Trip for Different Dies

To adjust the knock-off *D* (Figs. 3 and 9) for different thicknesses of dies, so that the rolls will come into contact with the board as the hammer rebounds, it is simply necessary to shift the knock-off on the friction bar until the bar is timed to fall at the same instant that the hammer rebounds. In setting the knock-off it should not be forgotten that the hammer falls several feet and has considerable velocity when it passes the knock-off, whereas the friction bar starts from rest as it is tripped from its seat and falls about four inches. It can readily be seen that the location of the knock-off on the friction bar will vary not only for the thickness of the dies but also for any great variation in the stroke of the hammer, being set high for a long stroke or thick dies, and low for a short stroke or thin dies.

On the Billings & Spencer drop-hammer, a knock-off plug *J*, Fig. 7 (see also *j*, Fig. 1), is forced back by an incline on the hammer a distance *x*, when the stop-pin *B* is free to fall through the elongated hole in the knock-off plug, thus allowing friction bar *K* to fall until the stop-pin bracket *C* strikes the rubber cushion *D*. When the roll-releasing lever *L* raises the friction bar enough for the stop-pin *B* to clear the knock-off plug *J*, a spring *S* pushes the latter forward under the stop-pin. The adjustment for different thicknesses of dies is made by swinging the stop-pin bracket *C* in an arc and again locking it to the friction bar, thus increasing or decreasing the distance *x* that the plug *J* must be pushed back before the stop-pin can fall through.

Fig. 14 shows the Williams, White & Co.'s construction which was also used on the old Bausch drop-hammer with but slight modification. The knock-off *A* is clamped adjustably to a short vertical bar *B* behind the friction bar *K* and a "catch-up" *C*, fastened to the bottom of bar *B*, is given a rotary movement and is thus disengaged from a slot in the friction bar when the hammer descends. The time of release depends on the vertical location of the knock-off *A*. The thickness of the dies that can be used depends on the amount that the knock-off can be adjusted along this bar.

Bottom Stop for Friction Bar

After the hammer has fallen, the power required to start it upward depends upon the amount of rebound, which, in turn, is affected by the nature of the work and the solidity of the blows. The first few blows on the heated stock are accompanied by considerably less rebound than when the forging is about completed and the dies are close together, because in the latter case the upper die strikes more solidly. Evidently the full gripping effect of the rolls should be exerted on the lifting board later when there is considerable rebound in order to secure the advantage of the rebound. The final gripping of the rolls is retarded somewhat, when solid blows are being struck, by a slight rebound of the friction bar.

A bottom stop *O* (see Figs. 3 and 9) consisting of a small piece of steel is located below the friction bar so that the latter can only drop a predetermined distance, which, in any case, must be sufficient to give the rolls the required frictional grip upon the lifting board. Now when the hammer is striking soft heated stock, the friction bar, as it is tripped, does not fall with the same force as when the hammer is working "die to die" and is striking more solidly, because these solid blows result in a quicker downward movement of the bar; consequently the friction bar rebounds more and the rolls grip the board later when the hammer is striking solidly, so that the upward rebound is not checked but gives the hammer a start before the friction rolls grip the lifting board tightly. On the other hand, when the blows are upon soft and more plastic stock, the fall of the friction bar is not affected by the blows to the same extent, and as there is little rebound to the bar, the rolls grip the lifting board with full force at the same time that the bar reaches the end of its downward movement; hence, the full power of the rolls is obtained just when it is needed.

The bottom stop also serves another purpose in that it prevents the friction bar from falling a greater distance each time, thus wearing a deep groove across the board at the point of pick-up. As the bar and its attached parts must be heavy enough to give the required gripping pressure for lifting the hammer and die, this gripping effect would be excessive for light dies at the instant that the bar reached the lower end of its fall if there were no stop to arrest its downward movement, and a groove would soon be worn in the board. Leather

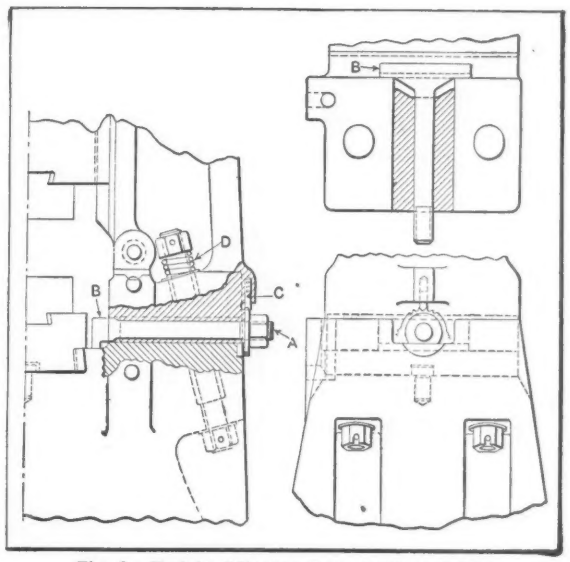


Fig. 6. Upright Adjusting Bolt of T-head Pattern

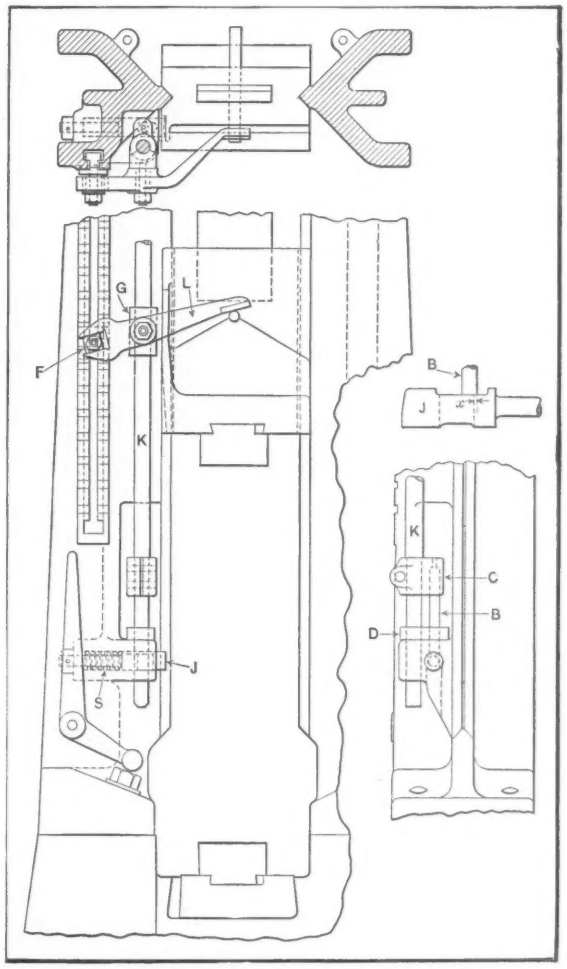


Fig. 7. Detail View of Releasing Lever and Automatic Trip of Drop-hammer shown in Fig. 1

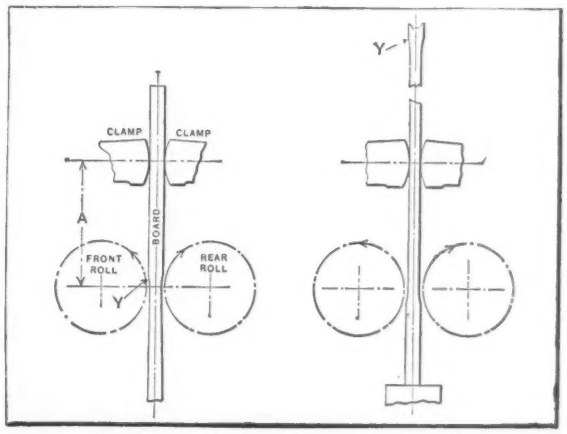


Fig. 8. Board Clamps located above Rolls

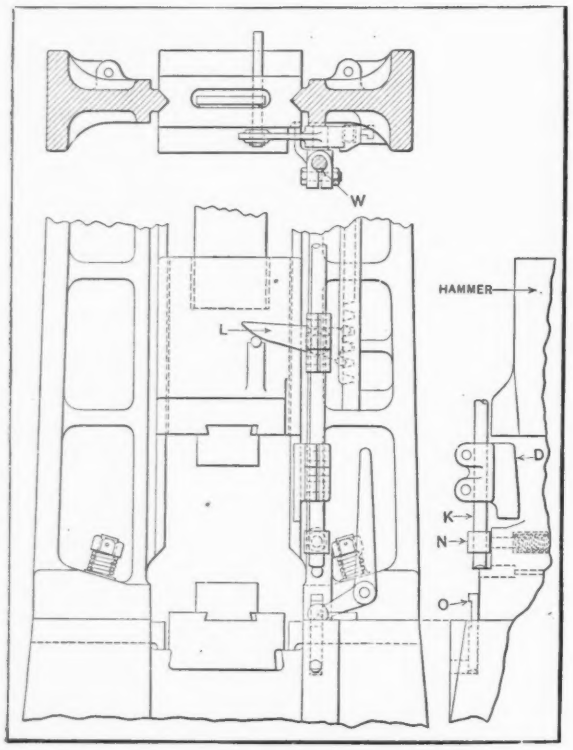


Fig. 9. Automatic Trip Mechanism—Rack and Segment Lever for Stroke Adjustment and Roll Release

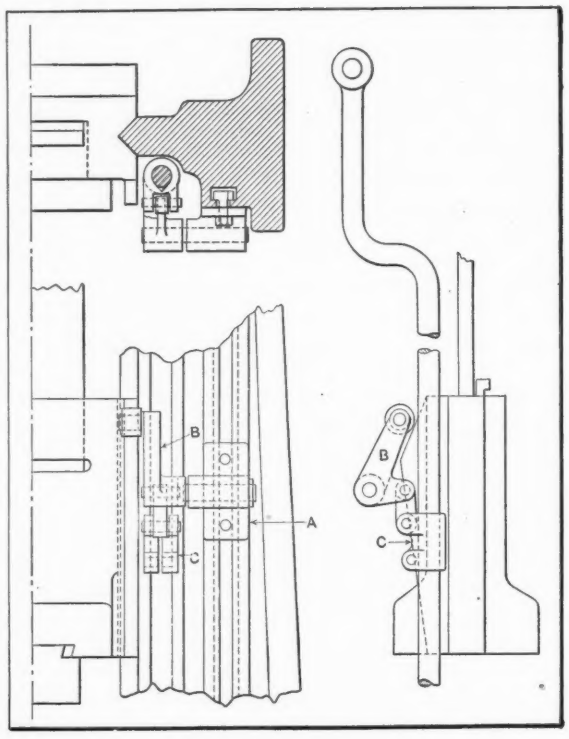


Fig. 10. Bellcrank Tripping Lever equipped with Roller

washers are placed under the bottom stop to cushion the fall of the friction bar.

It is evident from the foregoing that the first point of contact between the friction rolls and lifting board will vary with the variation of the rebound of the hammer, thus distributing the wear on the board. When a hammer is used continually upon a class of work that causes very little rebound, the wear is concentrated at one point, and the result is that the board does not last nearly as long as when a hammer is used for a more diversified line of work.

Roll-releasing Mechanisms

The general principle of the roll-releasing mechanism, which is the oldest and most common type, is illustrated in Fig. 3. It consists simply of a bracket *L*, which is clamped to the friction bar. This bracket has an extension that is engaged by the ascending hammer, thus raising the friction bar and releasing the rolls. This form of release is positive in action, but the mechanism is subjected to rather sudden shocks, owing to the fact that the heavy friction bar and attached parts are instantly started from rest and given the same upward velocity as that of the hammer.

With the construction shown in Fig. 10, the right-hand upright is cored for a T-slot to which an adjustable bracket *A* is clamped. This bracket carries a bellcrank or releasing lever *B*, the roller of which projects into the path of the hammer. There is an incline or cam path on the front of the hammer, the lower part of which operates the automatic knock-off, and the upper part, the roll release. As the hammer comes into contact with the roller on its upward stroke, the friction bar is raised at a much lower velocity than the hammer, the rate depending on the ratio of the arms and the angle of incline on the hammer. The adjustment for different lengths of stroke is made by changing the location of the lever bracket *A* in the T-slot and the friction-bar bracket *C* connected with the lever by a link.

With the Billings & Spencer release mechanism shown in Fig. 7, a lever *L* is pivoted on an adjustable bracket *G*, clamped to the friction bar. The long end of the lever projects into the path of a wood or fiber hammer pin, and the short end slides on a block that is pivoted at *F* to a bracket engaging a notched rack. The upward velocity of the friction bar is lower than that of the hammer in proportion to the ratio of the two arms of lever *L*, which is usually about 3 to 1. Variation in stroke is obtained by adjusting the friction-bar bracket *G* and the bracket *F*. The latter, in addition to a bolt for clamping, has a tongue that fits into one of the slots on the upright so that the bracket cannot slip.

The friction bar of the roll-releasing mechanism shown in Fig. 9 is practically straight, and the roll-releasing lever *L* is located on the inside of the friction bar, or next to the upright. The releasing lever is also straight and the end is in the form of a segment with teeth that engage a shrouded steel rack bolted to the upright. The adjustment for variation in stroke is made by simply loosening the clamp bolts in the lever bracket, taking hold of one end of the lever, and sliding the bracket along the friction bar until the teeth of

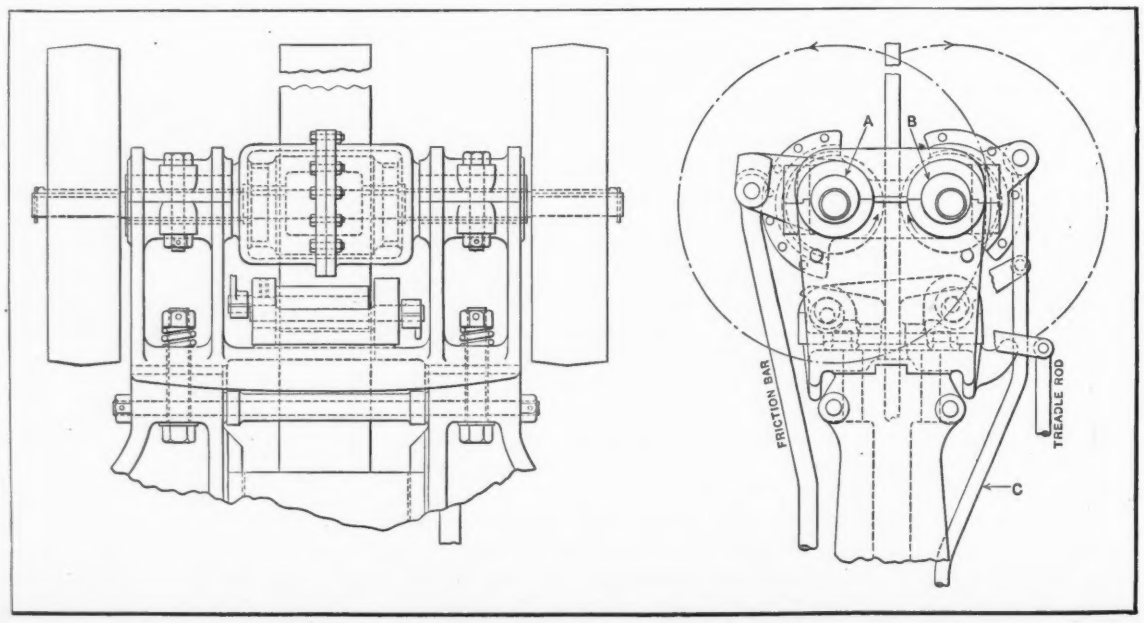


Fig. 11. Lifting Head having Eccentric Adjustment for Front and Rear Friction Rolls and Board Clamps

the segment are out of engagement with the rack; the segment lever will then slide freely to any position desired, when the teeth of the segment are again engaged with the rack and the bracket bolts tightened. One of the advantages claimed for this design is that it gives a greater travel to the friction bar in releasing than a simple lever, because as soon as the hammer pin comes into contact with the lever *L*, the segment moves up along the rack, thus constantly changing the pivot point.

A novel form of key such as is shown at *W*, Fig. 9, is used on practically all drop-hammers to prevent the releasing-lever bracket from turning on the friction bar. The front of the friction bar is flattened and the bracket is slotted out to form a seat for a triangular key. Thus it can readily be seen that as the clamp bolts are tightened, the key will effectually prevent the bracket from turning.

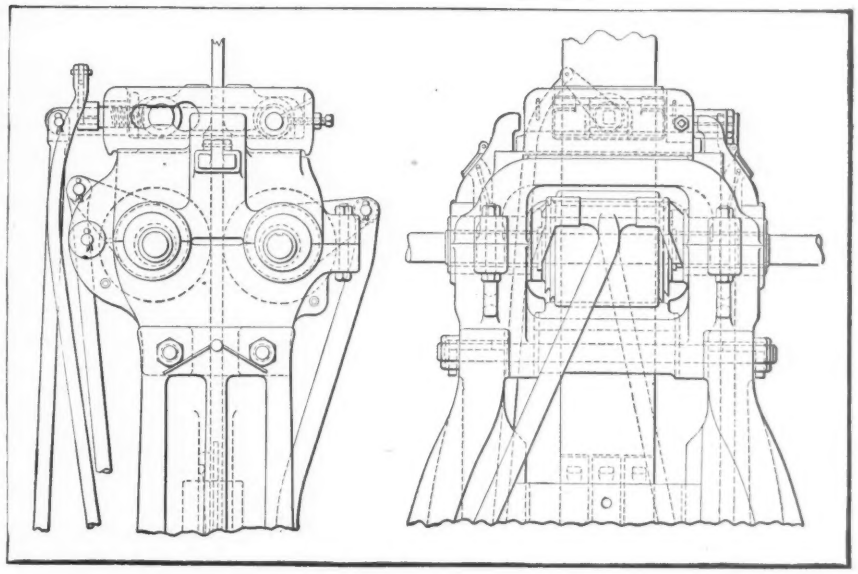


Fig. 13. Lifting Head having Eccentric Adjustment and Board Clamps above Friction Rolls

Head or Lifting Mechanisms

In all board drop-hammers, from the earliest types, the ram or hammer has been raised by rolls running in opposite directions, and the pressure is applied and released by one of the rolls (usually the front) which is mounted in or on an eccentric; the weight of the friction bar and its attached parts serves to hold the roll against the board, and the opposite roll is generally constructed so that it can be adjusted to compensate for wear of the board. Compressed air, steam and solenoid magnets have been used for operating the friction rolls. As early as 1907 the solenoid magnet received serious consideration, but at the time it seemed impossible to get a satisfactory magnet that would carry the necessary load and operate fast enough without heating and later crystallizing. Compressed air was used by one manufacturer of drop-hammers for a time, but the difficulty of keeping the joints tight was so great that the old friction bar construction was again employed.

Fig. 15 shows a side view of one design of head or lifting mechanism. This type of head is used with the latch or "catch-up hammer" previously referred to. The concern that builds this head also builds the board clamp type, but the roll and eccentric constructions are the same. The front roll is carried in two sliding boxes or bearings that are connected by links to a one-piece eccentric at the front. An arm keyed to one end of the eccentric is connected with an auxiliary wooden friction bar. The main friction bar is connected to the wooden bar by a bracket at the bottom. The roll release is in the form of a single bracket clamped to the friction bar, the arrangement being similar to that shown in Fig. 3. As the friction bar rises and falls, the front bearings approach toward and recede from the board on a straight line. The rear bearings are used to make adjustment for wear of the board, and are held in place by means of a set-screw and pull-back bolt behind each bearing.

Another design of lifting mechanism is shown in Fig. 19. The front roll eccentric is a one-piece steel casting. With this construction the roll and shaft have to be finished separately and the shaft is pressed into place by putting the roll in the hood and inserting the shaft through the ends of the eccentric. The bronze bushings are put in from the outside and pinned, and the walls are heavy enough to allow the key to pass through.

Front and Rear Eccentric Adjustment

The lifting mechanism shown in Fig. 11 is somewhat like the old Stiles head built in 1872 in that both the front and rear rolls and the board clamps are mounted in eccentrics; the front eccentric *A* is for operating and the rear eccentric *B* for adjustment. Both the rear roll and board clamp are connected to bars extending down the back of the uprights, so that adjustment for wear of the board can be made from the floor. The claim made for this construction is that the rolls and clamps are always in line. The roll eccentrics are hooded and are made in two pieces, and tongued and bolted in the center so that the roll and shaft can be finished together at one setting. The ends of the eccentrics can also be slipped over the ends of the shaft and roll and bolted in the center. The bronze bushings are fitted in the eccentrics from the inside before the eccentrics are bolted together. With this construction, new bushings can be put in without pressing the roll from the shaft. The plan view shows how the front eccentric arm is offset so that practically a straight friction bar can be used.

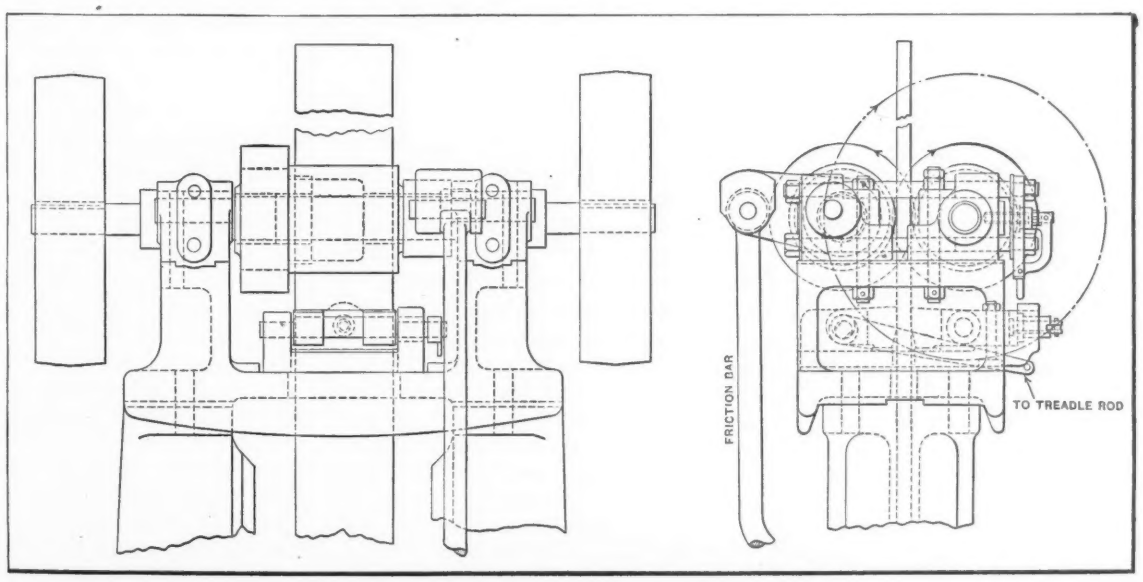


Fig. 12. Lifting Head equipped with Geared Friction Rolls

Another design of lifting mechanism with eccentric roll adjustment is shown in Fig. 13. The eccentric for adjusting the rear friction roll is a duplicate of the one used for engaging

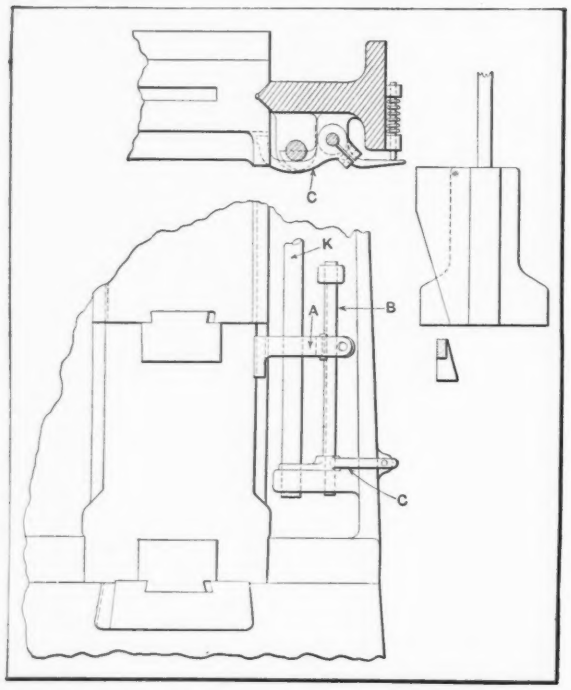


Fig. 14. Trip Mechanism of Swinging-latch Type

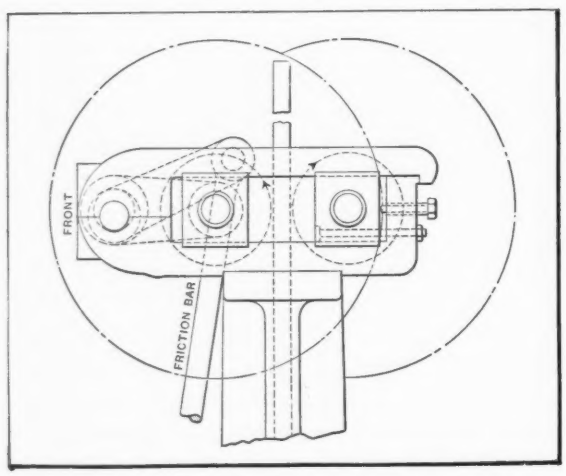


Fig. 15. Lifting Mechanism for Drop-hammer of Latch Type

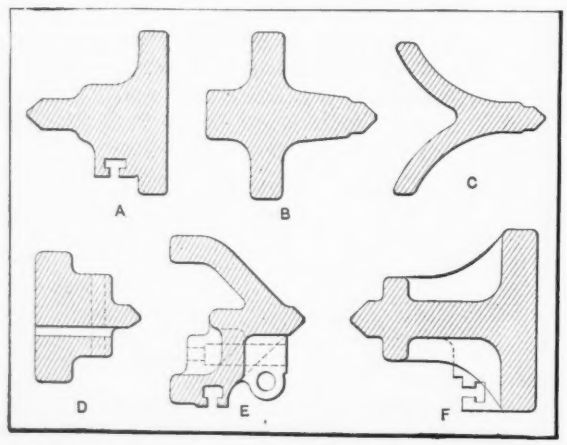


Fig. 16. Cross-sections of Drop-hammer Uprights. (A) Waterbury Farrel Foundry & Machine Co. (B) United Engineering Co. (C) E. W. Bliss Co. (D) Billings & Spencer Co.—Model B. (E) Billings & Spencer Co.—Models C and D. (F) Chambersburg Engineering Co.

the front friction roll. The adjustment of both the rear friction roll and of the rear board clamps is effected by means of bars extending down the rear sides of the upright to a point within easy reach of the operator, the same as in the design shown in Fig. 11. The lower ends of these rods pass through lugs and they are adjusted vertically by means of nuts above and below the lugs. The top of the head or lifter is cored out to form an oil reservoir, which is made large enough to hold several quarts of oil. Oil ducts with wicks lead down into the reservoir.

Geared Drive for Friction Rolls

The rolls of the lifting mechanism shown in Fig. 12 are geared together and both belt pulleys are mounted on one shaft instead of having a pulley on each shaft driven by open and crossed belts. The diagram Fig. 5 shows the shapes of the gear teeth. As the rolls always run in one direction, only one face of each tooth is an involute; the backs of the teeth are straight and coincide with a line drawn tangent to a circle somewhat smaller than the root circle and starting from a point so that the top of each tooth is approximately ¼ inch wide. When the rolls are geared (which is the arrangement on several well-known drop-hammers) the driving pulleys are both on the rear shaft, and the front roll runs free on an eccentric similar to the board clamp eccentric. The claims for this construction are that the belt pull is even on both bearings, a cross belt is avoided, and a constant velocity ratio is maintained between both rolls. The greatest bearing pressure, however, is due to the roll pressure against the board. The gearing is also subjected to considerable wear, as the teeth only bear on the points when the board is new, and the limit to the adjustment for board wear is the amount that the gears can be adjusted before the teeth bear at the bottom, which is usually about 5/16 inch. Instead of using geared friction rolls, both the front and rear rolls of several other well-known drop-hammers are driven by separate belts; one belt is open and the other crossed, if the drive is from one lineshaft.

The roll shaft bearings shown in Fig. 12 are separate from the main head casting, being tongued and bolted to the top. The pressure from the rolls in contact with the board is taken by tie-rods. The position of the front bearing is stationary, but the rear bearing is adjustable and the pressure is transferred from the adjusting stud through a nut to a plate or bar connecting the tie-rods and thus to the tie-rods themselves. The rear roll is keyed or otherwise fastened to the driving shaft and carries both driving pulleys. The front roll runs free on the eccentric shaft. The gears connecting the rolls are usually of steel castings and are screwed into the end of the cast-iron roll. The lifting mechanism is held in line with the uprights by a tongue or guide, and is attached to the top of the uprights by four through bolts. The bolts on the right-hand or friction-bar side are a tight fit, but those on the left-hand side have slotted holes to permit adjustment for wear of the hammer guides. Taking up for wear on the left-hand side only, keeps the friction bar perpendicular.

Oil Guards for Friction Rolls

Oil on the board has always been a bother to the hammer user because the friction rolls and board clamps cannot grip an oily board properly, and a certain amount of oil will work out of the bearings and get on the board in spite of all that can be done in the way of wipers, oil guards, etc. Fireclay or soft coal dust applied to the surface, usually crushed in from the face of the clamps, presents a good gripping surface but does not help the edge of the planing tools if the boards are replaned. The right- and left-hand V-threads shown on the ends of lifting roll *A* in Fig. 17 provide an effective oil guard for the rolls. The threads carry the oil back and away from the body of the roll. As the rear roll runs in the opposite direction, the threads are reversed. The oil guard shown at *B* consists of flanges inclining away from the body of the roll; this guard depends on centrifugal force to throw the oil off.

Control of Board Clamps

The board clamps act as toggles and hold the hammer or ram suspended by gripping the board. The front clamp is usually mounted on an eccentric and is connected to a foot-treadle by means of a lever and rod as shown in Fig. 1. As the foot-treadle *h* is depressed, the treadle rod and the treadle lever which is connected to the front clamp are raised. As the front eccentric is located above the center of rotation, the front clamp is drawn back from the board, thus releasing the hammer. To strike a hard blow, the treadle is fully depressed, completely releasing the clamps; to cushion or stroke a light blow, the treadle is only partially depressed so that the board drags through the clamps at the velocity desired. If a single blow is desired, the treadle is depressed until the hammer strikes its blow, when it is released. For a series of blows, the treadle is held down and then the hammer operates automatically until the treadle is released. Both clamps should be mounted on shafts free to lift and relieve themselves when the board is going up and the treadle has been released to lock the clamps. The instant the board starts downward the friction against the side or face of

the board clamps causes them to grip the board instantly, the weight of the hammer tightening the grip.

Floating Board Clamps

From the beginning of drop-hammer development, it was hard to keep a board true, and for this reason Stiles patented the floating board clamp in 1872. This type of clamp is free to move in any direction to allow for a warped board and thus prevent the board from bearing heavily against either roll, which would quickly heat the rolls and prevent the hammer from falling free. The board clamp eccentrics of some early designs are fitted directly into the main head casting instead of in a floating bracket; this construction was soon discarded for the floating clamp, as it was found that boards could not be used where they were warped or twisted to any extent.

The rear clamp is adjusted to compensate for wear of the board by means of set-screws and lock-nuts behind the rear clamp holder on several designs of drop-hammers, whereas eccentrics are utilized on other makes. In the design shown in Fig. 11, the front and rear clamp eccentrics are duplicates and the rear eccentric is used for adjustment only; a lever clamped to the end of the eccentric connects with a bar or rod that leads down the back of the left upright and is locked in position within easy reach of the operator, as previously mentioned. The adjustment of the rear clamp on another design is made by a taper wedge behind the clamp, which is connected to a bar extending down the back of an upright. An earlier model of the same make of hammer was equipped with a screw adjustment as shown in Fig. 13.

Location of Board Clamps

The board clamps are below the friction rolls on the lifting head shown in Fig. 11 and above the rolls on the design shown in Fig. 13. When the clamps are located above the rolls the oil from the roll bearing cannot reach the clamping surfaces and thus reduce the effectiveness of the grip on the board. Many drop-hammer manufacturers and users, however, contend that it is better to have the board clamps below the rolls for the following reasons: When the clamps are above the rolls as indicated by the diagram Fig. 8, they must grip the board on a surface that passes between the rolls at every stroke, as indicated by the right-hand view which shows the hammer in its upper position. If the same stroke is used for a long time the clamps make an impression in the board at the point where they constantly grip it; moreover, the boards on all makes of hammers wear more or less tapering from the point of pick-up to the point of release, which makes it more difficult for the clamp to secure a good grip. The result is that the board sometimes slips through the clamps until they engage the point of pick-up, leaving the hammer suspended at a height equal to the distance *A*, between the center line of the rolls and the center line of the board clamps.

That part of the board above the point of pick-up is never engaged by the roll, but must pass through the clamps before the hammer can strike its blow. The result is that when a board is badly worn, if the clamps are set tight enough to grip the board on the thin part, the force of the blow is cushioned or retarded when the thick part of the board passes between the clamps. Gripping the board on a surface that passes between the rolls also requires adjustment to compensate for the change in the thickness of the board. For cushioning the blow in drawing work, edging, etc., the location of the clamps above the rolls is an advantage, because when the treadle is lightly depressed the board slips through the clamps, until the thick part of the board above the point of pick-up is wedged between the clamps, thus arresting the movement of the hammer before the die strikes unless the treadle is further depressed. When the clamps are below the rolls, as indicated by the diagram Fig. 18, they grip the board when the hammer is at the top of its stroke at a point which never passes between the rolls; consequently this gripping surface is not worn except by the action of the clamps, and when the treadle is released there is no enlarged point of the board to interfere with the fall of the hammer.

On the other hand, it is claimed that if the clamps are designed with sufficient action or throw to the eccentric actuating them there is no more tendency for the board to slip through the clamps when they are above the rolls than when below the rolls. Moreover, if the clamps have a sufficient radius of action, it is contended that the force of the blows will not be cushioned or retarded by the thick part of the board above the point of pick-up, unless this cushioning effect is desired by the operator, in which case it is obtained by the foot-treadle control. While it is true that little or no adjustment for board wear is required when the clamps are below the friction rolls, the adjustment, in any

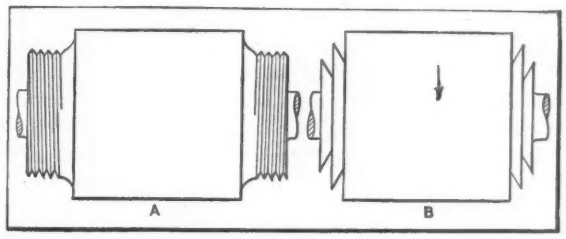


Fig. 17. Friction Rolls provided with Oil Guards of Different Types

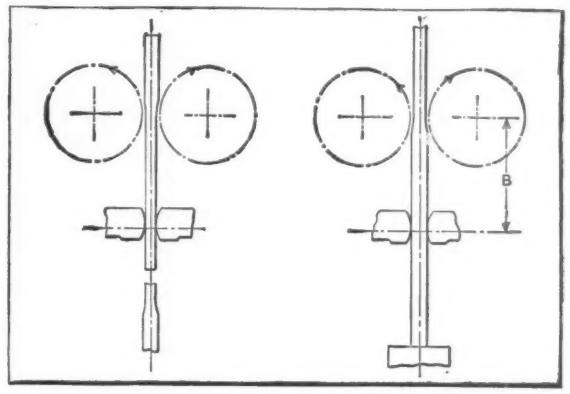


Fig. 18. Board Clamps located below Rolls

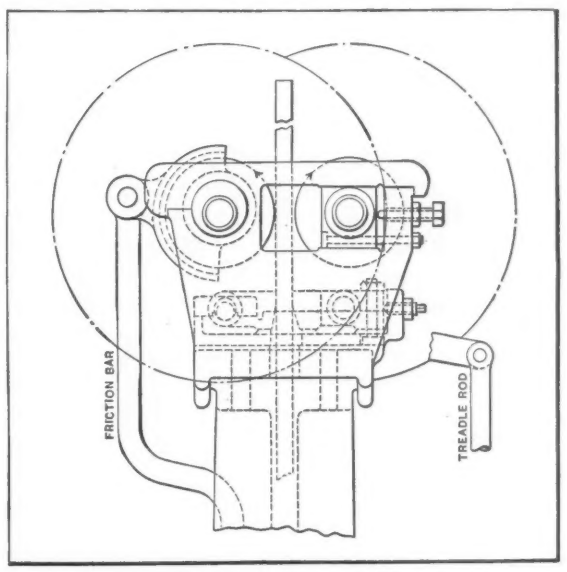


Fig. 19. Lifting Head having eccentrically mounted Front Roll and Bolt Adjustment for Rear Roll

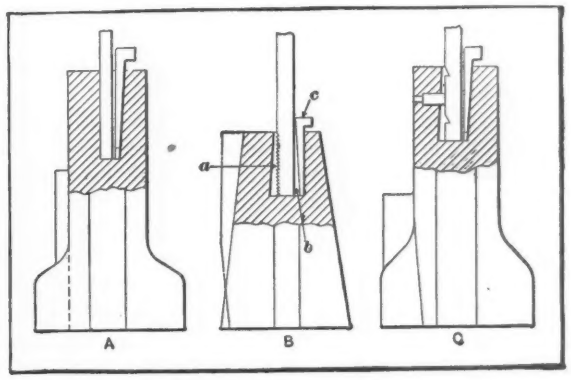


Fig. 20. Methods of holding Lifting Boards in Hammers. (A) Billings & Spencer Co. (B) E. W. Bliss Co. (C) Chambersburg Engineering Co.

case, can be made easily and quickly on drop-hammers having the extension rods at the rear of the uprights.

The manufacturers of the design of drop-hammer, the upper part of which is shown in Fig. 13, claim a safety feature in that if the board slips through the clamps owing to the jar of adjacent hammers in operation, the descent of the hammer will be stopped before the dies come together, because the thicker or unused portion of the board reaches the clamps

before the dies touch each other, so that there is a space between the dies of eight or ten inches. With the clamps below the rolls, they would not engage this thick part of the board above the point of pick-up, so that in case of slippage the fall of the hammer would not be retarded, but advocates of the latter design contend that the board is not so likely to slip when the clamps are placed below the rolls for the reason previously given.

In the production of drop-forgings it is desirable in most cases to strike a light final blow, especially where the forging is hot-trimmed, because the trimming operation often bends the forging slightly and the final blow is necessary to straighten it. This blow should preferably be a light one, as otherwise it will form another fin on the forging which must eventually be ground off. Furthermore, in making a great many forgings that are finally cold-trimmed, cutters are used on the hammer for cutting the forging from the bar, and it is desirable to use a light blow for this cutting-off operation. With the clamps above the rolls, this light blow may readily be obtained, owing to the cushioning effect of the enlarged part of the board, whereas when the clamps are below the rolls it is more difficult to secure the proper cushioning effect. The fact that the location of the clamps above the rolls keeps them free from oil is a feature recognized by the advocates of both designs.

Cross-sectional Shapes of Uprights

The cross-sectional shapes of the uprights on different makes of drop-hammers are shown in Fig. 16. There is a single V-shaped guide that is cast integral with each upright. The bolt holes at the upper and lower ends of the upright are elongated to allow for lateral adjustment in order to compensate for wear between the guides. As the V-shaped ways on the upright are longer than the average stroke of the hammer, they wear faster at the bottom than at the top, and for that reason the ways are planed open at the top, the amount depending somewhat upon the size of the drop-hammer. The manufacturers represented by the various uprights illustrated in Fig. 16 are as follows: *A*, Waterbury Farrel Foundry & Machine Co.; *B*, United Engineering Co.; *C*, E. W. Bliss Co.; *D*, Billings & Spencer Co., Model B; *E*, Billings & Spencer Co., Models D and C; *F*, Chambersburg Engineering Co.

Methods of Holding Boards in Hammers

Three methods of attaching boards to hammers are illustrated in Fig. 20. The method employed in the Billings & Spencer drop-hammer is shown at *A*. The mortise for receiving the board is comparatively deep in order to insure a good frictional grip, and the board is held in place by several wedges which bear against a thin plate placed between the wedges and the board.

The method used by the E. W. Bliss Co. for attaching the board to the drop-hammer is illustrated at *B*. Before placing the board in the hammer head, a sawtooth taper wedge *a* should be placed in position in the recess in the hammer, with the thick part down and the teeth bearing against the board, as the illustration indicates. After inserting the board in the mortise, the taper plate *b* should be set in back of it, with the thick part down, and three or four taper keys *c* then driven in. The inertia due to the falling hammer and the weight of the keys tends to drive them in, thus holding the board securely.

The method adopted by the Chambersburg Engineering Co. is illustrated at *C*. This is similar in principle to the arrangement just described, although the board grip differs somewhat in form. These holding plates or board grips are placed at the front of the ram and the board wedges are driven in from the rear, a few blows from the light sledge being sufficient. It is not necessary to nick the board for the board grips, as they readily seat themselves after a few blows. The under-cut or angle at the front of the hammer holds the grips in position, and they are further secured by means of pins which also prevent them from being removed with the board.

Relative Fields of Board and Steam Drop-hammers

Board drop-hammers can be used economically on small work that requires but little "breaking-down" or forging into shape, and the weight of the ram most commonly used is from 500 to 2000 pounds. Work requiring hammers much heavier than this generally needs considerable breaking-down and, with few exceptions, can be done to better advantage in a steam drop-hammer or forging machine. A properly designed modern board drop-hammer on light work that requires but little "edging" or breaking-down, will hold its own against the steam drop-hammer at two-thirds the upkeep cost. For work that requires more than a few blows to finish it, the steam drop-hammer will produce almost one-third more work per day, but the operating cost will be higher.

Most modern board drop-hammers run so fast on their minimum stroke that the operator has just time to change the work from the break-down to the finishing impression. The small steam drop-hammers usually run so fast that on small work it is necessary for the operator to work the treadle for each blow.

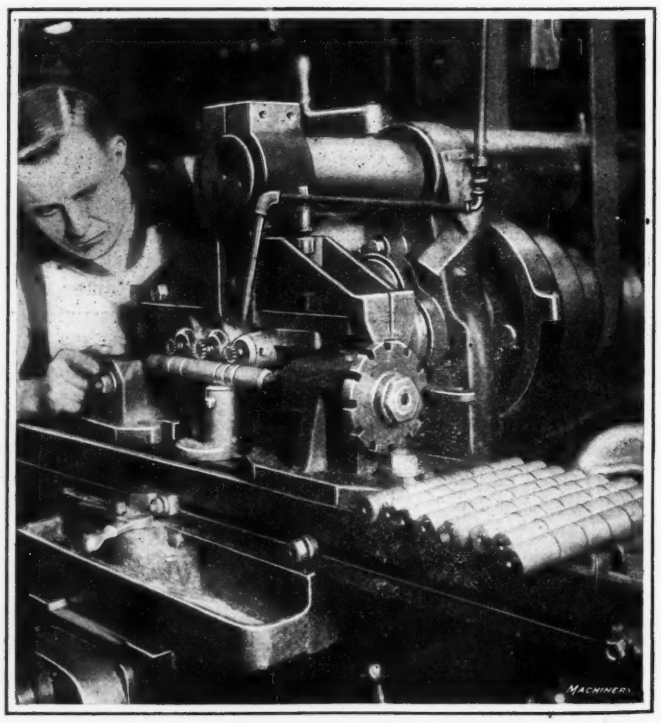
* * *

WOODRUFF KEYWAY MILLING ATTACHMENT

The milling attachment shown in the accompanying illustration is one of the numerous contrivances for increasing production in use at the plant of the Maxwell Motor Co., New Castle, Ind. This milling attachment consists of a casting, the upper portion of which is bored out to fit the over-arm of the milling machine, while the lower portion has three bearings attached to it for the three key cutter shafts to run in. The cutter shafts are driven by gears from the main driving spindle of the milling machine. The machine for which this attachment was designed is a plain Cincinnati No. 2 milling machine.

The magneto gear shaft which is mounted on the centers is made of nickel steel and has three Woodruff keyways cut in it, the sizes of which are Nos. 8, A and 5. The speed at which the cutters are run is 225 R. P. M. All three keyways are cut simultaneously. The magneto gear shaft is mounted on the centers as shown, and the table is raised on the vertical column until the desired depth of keyway is secured. The production from this operation is 450 shafts per ten-hour day, which is approximately three times as much as was secured when one keyway was milled at a time on a hand milling machine.

V. B.



Milling Three Woodruff Keyways Simultaneously

AUTOMOBILE CUSHION SPRINGS*

METHODS OF JAPANNING AND MEANS OF CONVEYING PRODUCT

BY E. F. LAKE†

THE methods of manufacturing the springs used in upholstering the cushions of an automobile are rapidly being revolutionized. As none of the automobile companies have thought it advisable to manufacture their own cushion springs, owing to the fact that this business has been specialized by wire spring makers, the result has been that those making coil springs have increased their plants and enlarged their business to such an extent that special and automatic machines, as well as other labor-saving equipment, are now being sought to lower the cost of production.

The Jackson Cushion Spring Co., Jackson, Mich., decided to make some radical changes in its methods a few months ago, and to this end called upon the writer to study its manufacturing methods, gather data and make suggestions as to what might be done to lower the cost of production. The equipment illustrated and described in this article is the direct result of the suggestions made. After the equipment had been in operation four weeks, it proved so successful that the company ordered some five hundred feet of track added to the trolley system and a second japan dip tank installed with its hoisting apparatus. Since this time other additions have been made to the trolley track and spring carriers.

Description of Equipment

The complete equipment consists of 1800 feet of trolley tracking; a japan dip tank 10 feet long, 2½ feet wide and 6 feet deep; an electric hoisting apparatus over the dip tank; a drain board 25 feet long; a three-compartment japan baking oven 50 feet long; and a fuel oil plant to furnish heat to the oven. Fig. 1 shows a section of the trolley system from the middle of the shop looking north. Along the right side of this picture the springs may be seen hanging from the spring carriers and trolleys that are located on numerous side tracks. A somewhat better idea of the general arrangement of these may be obtained by an inspection of the plan view, Fig. 3, in which the sidings are shown at *A*. The letter *A* also denotes the same part in Figs. 1 and 2.

Construction of Spring Carriers

At this point the work is started by hanging the springs on spring carriers, several of which may be noted empty and hanging from different parts of the track. The details of construction are more clearly shown in Fig. 6. The body of the carrier is formed of a 2-inch gas pipe which has caps screwed on each end, the entire length being 8 feet, 4 inches. Six of these carriers just fill an oven compartment which is 50 feet, 2 inches long on the inside. The hooks on which the springs are hung are made by bending ⅜-inch strong steel rods to the desired shape and springing them along the gas pipe. It will be seen that they can be easily adjusted along the pipes by sliding, to allow for springs that differ in thickness. The bolts *H*, Fig. 5, pass through the gas pipe and into four-wheel roller bearing trolleys that roll inside the tracks. These ¾-inch bolts support the gas pipe carrier with its load of springs in such a way that it can be readily pushed to any part of the trolley system. It will be seen that the carriers are very simple and cheap in their construction. As soon as a carrier has been completely loaded, it is switched onto the main line track *B*, Fig. 1, from which it is rolled into the japanning room. At the left may be seen two side tracks *C* where springs can be switched and stored while waiting their turn to be dipped in the japan tank. Fig. 2 shows this trolley system looking south from the far end of Fig. 1. The curves and track that carry the work from both ends of the shop and switch it into the japanning room are shown at *D*. At *E* may be seen one of the spring assembly or inspector's benches where the springs are loaded on the carriers. The work is switched from bench sidings to the main line on one of the curves shown at *F*.

Referring once more to Fig. 3, the ten sidings at which the springs are loaded on the carriers by the inspectors can be seen at *A*; the curve *F* and the switches that turn the work into the main track are a part of these sidings. The plan view which shows the track in outline also gives a good idea of the layout of tracks leading into the japanning room; the japan dip tanks; the drain boards; the three-compartment japan baking oven; the room where the springs are crated; the doors through which these are loaded into the freight cars and the door through which the empty spring carriers are returned to the siding *A* to be reloaded. Four lines of track lead to the japan dip tank and three of these tracks converge at the tank, while the fourth comes from the opposite side

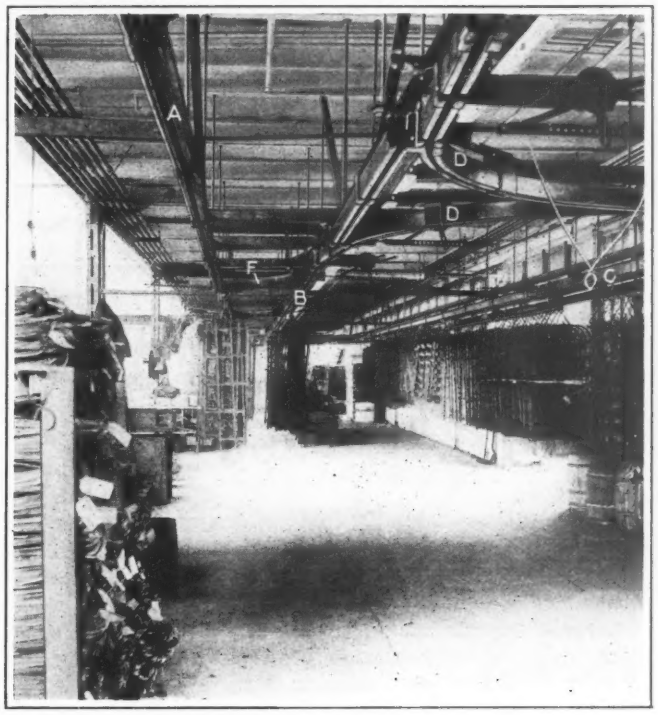


Fig. 2. Trolley System, looking South from North End

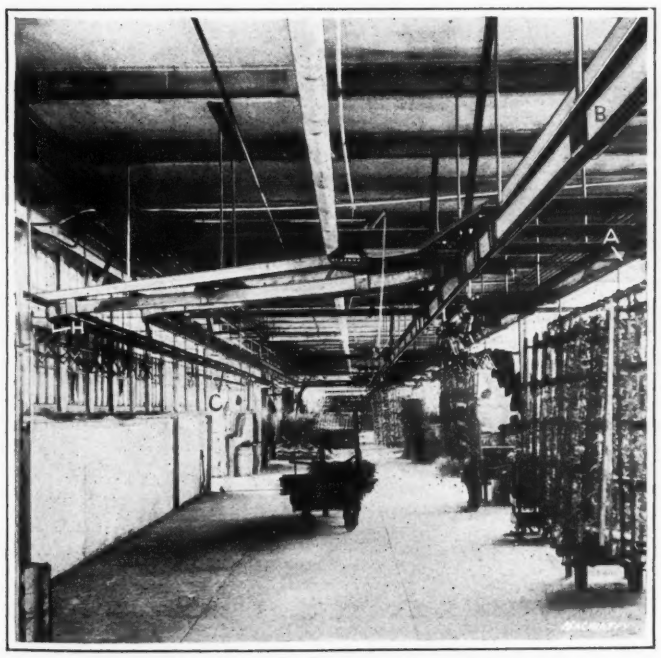


Fig. 1. Trolley System, looking North from Center

* For previous information on springs published in MACHINERY, see "Wire Springs" in March, 1915, and articles there referred to.

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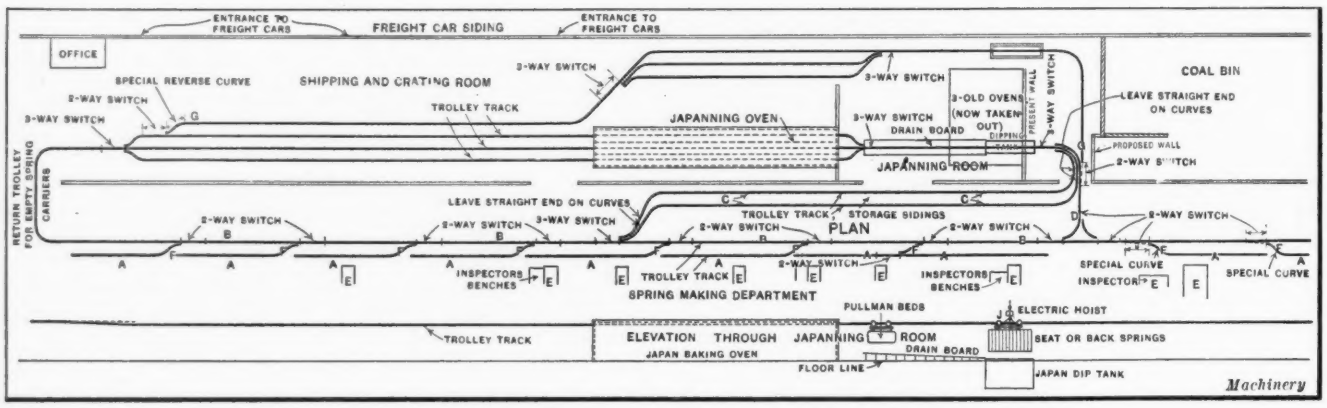


Fig. 3. Plan and Elevation of Trolley System for handling Cushion Springs

of the shop and is switched to one of these three in the other room. After running over the dip tank and drain board, the trolley system again branches out into three tracks, one of which goes to the center of each of the three compartments in the japan baking oven. Once more the three tracks converge into one where the empty spring carriers go through the door to return to the inspector's benches for reloading.

Prior to the installation of this trolley system, the work was loaded on floor trucks similar to those shown in Figs. 1 and 2. This method of handling caused considerable trouble, as the trucks would accumulate along the wall and it was a daily occurrence for this gangway to be so full of trucks that another one could not be pushed through without moving some of those already there. Assembled springs were frequently thrown to the floor while waiting for trucks to be extricated from the jam and emptied, all of which necessitated extra work in handling the springs and interrupted the steady movement of the work in one direction. It can easily be seen that a trolley system of this kind is a great labor saver by keeping the work moving in one direction in a continuous procession, the empty carriers coming back around the other end of the loop. The arrangement of the track is such that it would be impossible for the work to travel backward, as it would be blocked by the work that was coming forward. The illustrations Figs. 1 and 2 were taken at a time when the production of springs was at its height, and they plainly show how little chance there is for congestion. During January, when the old method of handling was in use, it was difficult to walk through this gangway on account of the number of floor trucks that were in the way. At the time when these photographs were taken, there were from 10 to 15 per cent more springs turned out than in January.

Types of Springs Handled

Fig. 4 shows a collection of springs of different sizes and shapes that are handled by the trolley system with equal quickness and saving of labor. The springs vary from the loose coiled springs sold by the gross to the full size assembled bed spring. The coil springs may be thrown into wire baskets which hang from the work carriers, or they can be tied up into bundles as shown at *Z* and hung on the carrier hooks. Band irons, to which three or four springs are fastened, form an assembly which is called a strip. These strips may be tied into bundles as shown at *Y* and hung on the carrier hooks or thrown loosely into wire baskets hung on the same hook. The individual seat springs *X* are hung from the carriers two and three deep, and a full load consists of from twenty-four to fifty-four springs, according to their thickness. Another type of spring is shown at *W*, this being a back spring for an individual automobile seat. A full carrier load of these springs, hung four deep, would be seventy-two springs. Springs of this type are sometimes used for the sides of rear automobile seats. The springs shown at *V* and *U* are, respectively, the types used for the backs and seats of automobile seats. From twelve to eighteen of these springs form a full load, as they hang but one deep. Springs *T* are used for the beds in the upper berths of Pullman cars.

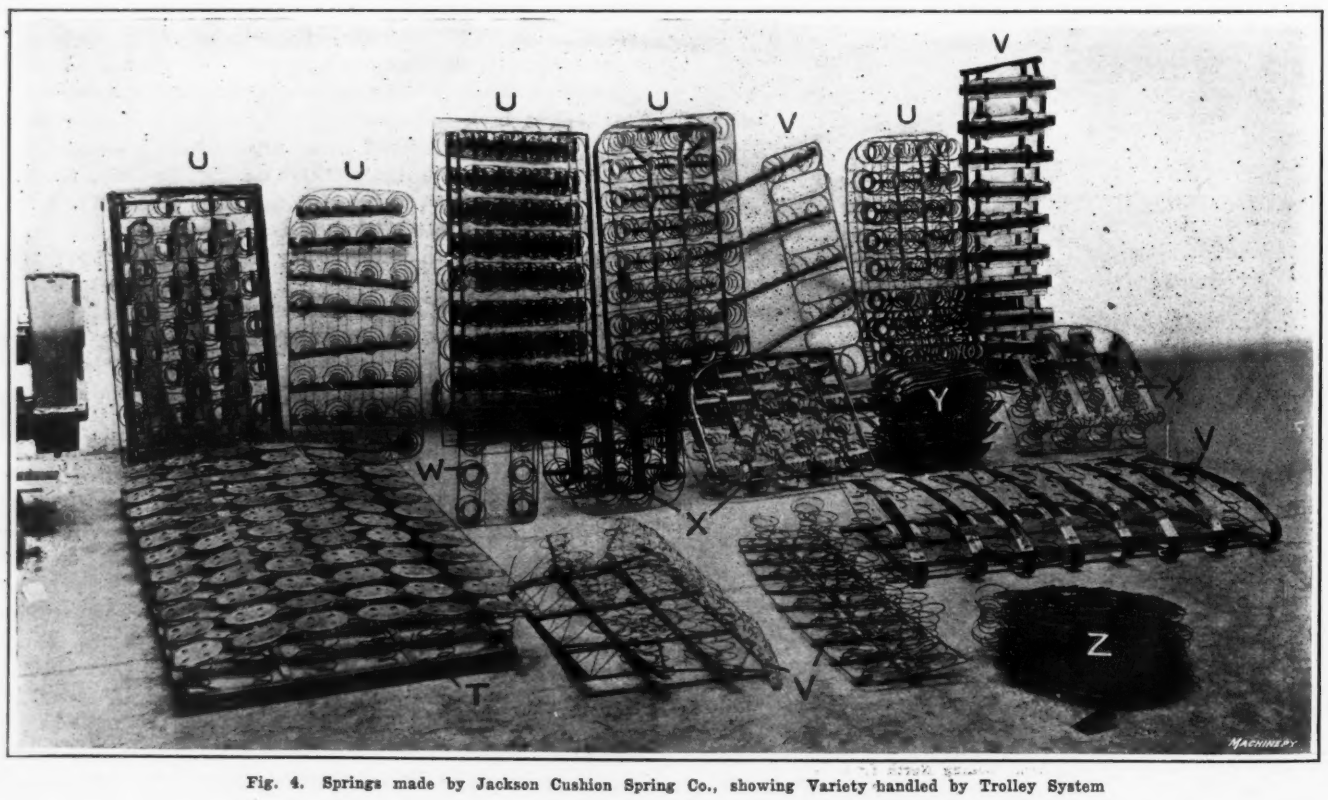


Fig. 4. Springs made by Jackson Cushion Spring Co., showing Variety handled by Trolley System

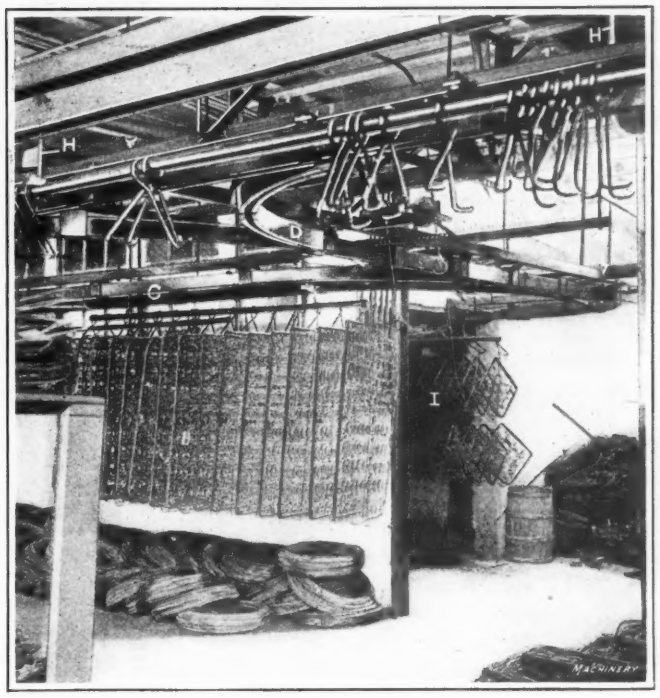


Fig. 5. Four Trolley Tracks passing through Door to unite at Japan Dip Tank

Arrangement for Japan Dip

Referring to Fig. 5 it will be seen that the four tracks come together to pass through the door into the japanning room and unite at the dipping tank. In the foreground at the upper part of the illustration can be plainly seen the carrier hooks on which the springs are hung. The load of springs *I* is just entering the loose piece of track over the dip tank to be lowered into the japan tank. It may be noted here that the trolley track, with its switches, curves, hangers, etc., is the product of the Richards-Wilcox Mfg. Co., Aurora, Ill. A very good view of the hoisting apparatus is shown in Fig. 6. The electric hoist itself is located in the dog-house overhead, and is therefore not apparent in the illustration. It is, however, a standard type of electric hoist made by the Detroit Hoist & Machine Co., which is geared to lower the cable at the rate of 50 feet per minute, at which speed it has a capacity of 1000 pounds, which is ample, as a load of springs never weighs more than 300 pounds. The two cables *K* are lowered simultaneously from the drum of the hoist, traveling over the sheave wheels *L*, and are leaded into the blocks *M*, which are bolted to the loose track *J*. When the track is lowered, the spring bars *N* push the blocks up into the track to prevent the wheels from rolling out and permitting the load to fall. As the load is raised to its position, the tapered ends of blocks *M* enter holes in the blocks *O* and guide the apparatus back to its correct position. The sheet metal forms *P* at each end of the gap, serve to guide the loose track *J* into correct alignment with the track at both ends.

The electric hoist is started by means of a switch when the spring load is ready to be lowered into the japan, and when the springs are within six inches of the bottom of the japan tank, the hoist automatically reverses and raises the load again to the track. When it reaches the top, another trip automatically stops the hoist when track *J* has reached its proper position and is in alignment with the track at both ends. The trip blocks are movable so that the upper and lower limits of the hoist travel can be set at any point desired. In connection with this japanning operation, a rather unusual procedure was introduced by putting sufficient water in the japan tank to reach within twenty-four inches of the top. Enough japan was then put in the tank to bring the level to within six inches of the top, and as the japan is lighter than water, it always remains on top. Therefore, when the springs are lowered into the bath, they are coated with japan before they reach the water, and as the water cannot wash the japan off, it cannot attack the steel to form rust. The amount of saving will be evident from the statement that approximately fifteen barrels of water and five barrels of japan are necessary to fill the tank to the desired level, so that it is evident that about fifteen barrels of japan are saved.

Fig. 6. Dipping Springs into Japan with Electric Hoisting Apparatus

After the dipping operation has taken place, the casting *R* must be moved out of the way before the spring loads can travel forward once more. This casting acts as a buffer block against which the end of the gas pipe strikes when the springs are rolled onto track *J*, thus stopping the load in the right position to be lowered. This buffer projects from a sleeve which revolves on a casting fastened to the track. After the loose piece of track is raised into position, the slot *T* must be brought opposite the opening in the bottom of the track. The bolts *H* which support the carriers on the trolleys can then pass through and the work travels forward. The buffer is controlled by pulling the handle *S*, to which is attached a wire rope passing over the pulleys shown, the other end of which is fastened to the buffer projection *R*, swinging it back toward the brick wall. This hoisting apparatus is very simple and works much easier than the description might indicate. The springs are lowered into the japan and then hoisted back, carried over the drain board and then to the three compartments of the oven much faster than they can be baked. As each oven compartment is designed to hold six loads and does the baking in twenty minutes, it will be seen that the hoisting apparatus handles eighteen loads every twenty minutes, or fifty-four loads per hour. The capacity of the hoist is ample for the work, and arrangements have been made for a fourth oven compartment which can easily be taken care of by the hoist in case it should be required.

Arrangement of Japanning Ovens

Fig. 7 shows the springs just after they have been dipped, as they are passing over the drain board and into the oven. It will be noticed that each oven door is furnished with a clock dial, and when the door is closed the hands of the dial are set at the time when the compartment was filled with springs. After twenty minutes has elapsed, during which time the japan is baked hard and dry, the operator pulls a wire that rings a bell located at the other end of the oven. This notifies the operator at the other end that one of the compartments has completed its bake, and by ringing the bell one, two or three times,

he is advised which oven is ready for discharge. The operator then pulls the springs out of this compartment and leaves it ready to be recharged. The thermometer shown on each door indicates the temperature in each compartment, and the oil burners can be regulated so that the temperature will be kept uniform at the desired degree.

Owing to the construction of the trolley system, the spring carriers can be easily moved. In fact, one man pulls the entire charge out of each compartment at one time, and as this consists of fifty feet of springs, or six carrier loads, it is evident that the work cannot be difficult since one man does it all day long. The same man also moves the springs to the part of the trolley system where the crating is done before shipping, at any desired point in the 100-foot length of the shipping room that the three tracks pass through.

Old Method of Handling

The old method of handling this work prior to the installation of the equipment mentioned consisted in the use of floor trucks, on which the springs were brought to the japan dip tank. They were then removed from the trucks one at a time and dipped in the japan, after which they were hung on a chain and moved over the drain board by turning a sprocket wheel with a crank. After this, they were removed from the chain and placed on iron trucks which were wheeled into the gas-fired japanning oven and baked. The baking frequently consumed an hour's time, and never less than forty minutes, to get the springs dry and hard enough to ship. After that, the trucks were trundled from the ovens to the shipping room, which usually required moving a number of other trucks (that had accumulated in the passageways) out of the way.

Four men were required on the day shift and four on the night shift to do this work, or a total of eight men for each working day. With the new equipment, one man keeps the springs moving to the electric hoist, another operates the hoist and fills the oven, and the third man pulls the springs out of the oven and delivers them to the shipping department to be crated. It is evident from this that the labor of five men was saved on this part of the work, and allowing for 300 working days per year, the amount saved in wages alone would be $3150. This saving would be increased considerably if the labor costs at the loading and crating end of the trolley system were also included.

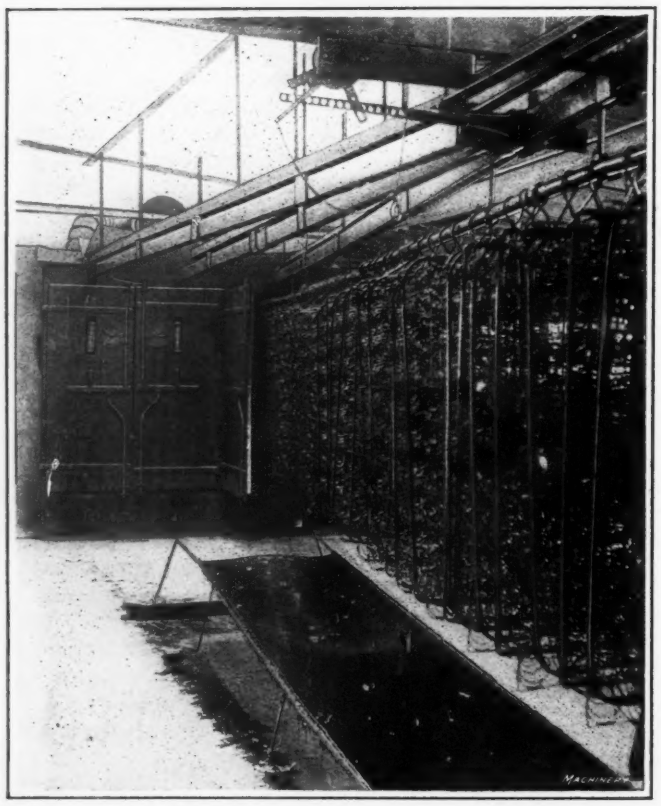


Fig. 7. Springs passing over Drain Board to fill One Compartment of Japan Baking Oven

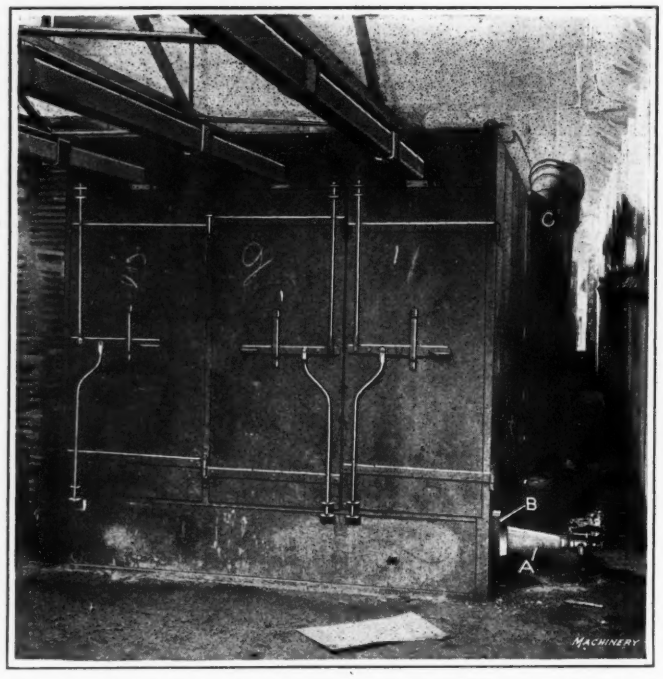


Fig. 8. Back of Oven where Springs are pulled out to be crated. Oil Burners for heating Ovens are shown in Passageway

When the new ovens are run at their full capacity, they will bake 585,000 cubic feet of springs per month of twenty-five working days of ten hours each. The old equipment had a capacity of only 378,000 cubic feet of springs during the month of January when working twenty-one hours per day. Thus, it may be seen that the new ovens have a capacity nearly three times as great as that obtained by the former equipment in a ten-hour day, and 55 per cent greater than that obtained by working the old ovens twenty-one hours per day in comparison with ten hours per day for the new ovens. Two compartments of the new ovens have a capacity of 390,000 cubic feet of springs during a month of twenty-five working days of ten hours each. This amount is 3 per cent more work than that produced by the gas-fired brick oven baked during January while working day and night shifts. The new ovens were built by the Detroit Heating & Lighting Co.

The back end of the oven is shown in Fig. 8, this being the point where the springs are pulled out and sent into the crating and shipping rooms. Fig. 9 shows the spring loads which have just come from the oven and are waiting to be removed by the men who do the crating. The Gilbert & Barker process for burning fuel oil under low pressure is used in heating the japan baking oven. Special features applied to this system make it most efficient for the work.

Method of Using Fuel Oil

In the construction of the oven, the heat is not applied directly to the work, as in heat-treating furnaces, but pipe coils are laid in the bottom of the oven and the oil flames are sent through these. In this way the ovens are heated by radiation, much as steam radiators are used for heating. The purpose of this arrangement is to prevent any of the products of combustion from entering the baking compartment to discolor, dull or otherwise ruin the smooth, glossy surface of the japan. Furthermore, the currents of air are prevented from starting up in the oven and stirring up dust particles that settle on the fresh japan. It is important to prevent this as far as possible, as these dust particles raise small lumps on the smooth japan surface, which are pyramidal in form so that they radiate light from all sides, which makes them appear much larger to the eye than they really are. When the pipe coils are arranged in this way, a dry heat is secured which bakes the japan quicker and harder than when moisture is present, as in the case of an open flame or when using steam heat. The atmosphere in the oven is also kept neutral, because there is no open flame to burn up the oxygen and leave an excess of nitrogen. Owing to these facts, less than 2 per cent of the work requires to be done over, while

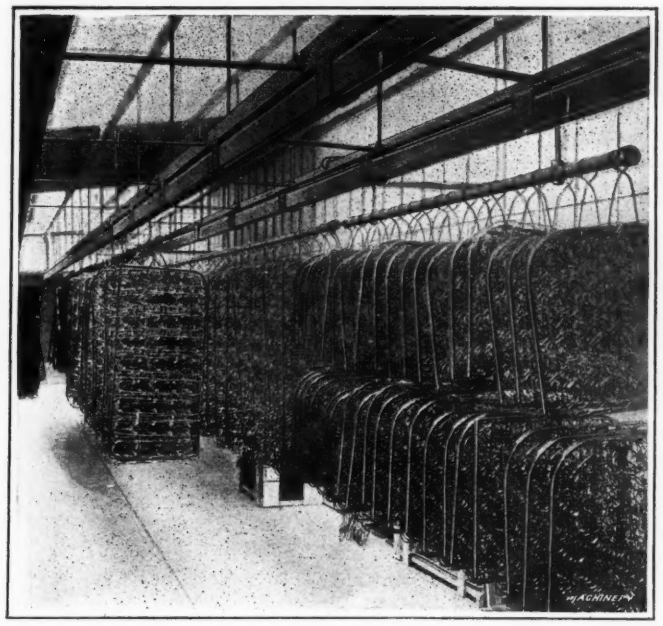


Fig. 9. Springs removed from Oven waiting to be crated and shipped

in the case of gas fires or steam-heated japanning ovens, from 10 to 20 per cent of the work has to be re-japanned and re-baked.

Details of Oil Burning Apparatus

Fig. 8 shows the special type of oil burners having a megaphone at *A* on the end. Five of these burners are arranged along each side of the 50-foot length of oven and each burner shoots the oil flame into a separate coil of 10-inch wrought iron pipe. The end of one of these coils is indicated at *B*. A sheet metal pipe *C* is used to convey the spent gases to a central stack that goes to the roof at the point where the coil leaves the oven. The fuel oil is vaporized inside the megaphone and combustion first takes place at this point, so that only the clean flame shoots into the pipe coil, as shown. This arrangement allows the operator to see the flame that enters the pipe coil and adjust the burner in such a way that there will be complete combustion of the fuel oil. If there should be an excess of oil, it would drop to the floor at the end of the megaphone. The importance of the megaphone burner should be emphasized in connection with construction of this kind, as without its use, the pipe coils will be destroyed in a few weeks, while with the construction advocated they will last several months. Another point of importance is that the pipe coils should be supported on rollers so that the expansion and contraction will not crack the piping. If any of the small details of this system are neglected, the result will be failure, but when all details are perfect the process works successfully and is by far the cheapest of any in fuel consumption and upkeep of which the writer has knowledge.

A special casting is placed in the outlet end of the pipe coil to reduce the 10-inch diameters to 4 inches, which leaves a large enough opening to carry away all the spent gases and holds the heat inside the pipe coil where it will radiate to the japan baking oven. If this were not done, 40 per cent of the heat generated by the oil flame would pass through the pipe coil and out of the stack. In one case known to the writer, a heavy sheet metal stack 3 feet in diameter was burned through by these gases some 2 feet above the roof of the building and 50 feet away from the heating coils, as measured by the piping through which the burning oil gases travel.

With a 10-inch pipe left open to the draft from a stack, the burning gases travel fairly quickly through vent pipes like that at *C*, and their heat will not be effective until they accumulate in the larger stacks outside the building. In an oven arranged like this, with ten burners and pipe coils venting into one central stack, it can be readily seen that there would be an intense heat at the point of concentration unless the flames were held back in the pipe coils until they had burned out. The simplest method of doing this is by means of a casting which reduces the outlet end of the pipe coil, thus obviating the necessity for dampers which burn out too easily.

Fig. 10 shows a floor plan and elevation which indicates the location of these pipe coils and oil burners. It will be seen that a heat insulated partition *F* extends clear to the floor and separates compartments 1 and 2 from compartment 3. This arrangement permits compartment 3 to be fired alone;

COMPARATIVE COSTS OF GAS AND FUEL OIL IN HEATING JAPANNING OVENS

General Information	Gas Fuel—Three Ovens	Fuel Oil—Three Compartments	Fuel Oil—Two Compartments
Truck and carrier capacities (cubic feet)	105	260	.....
Oven or compartment capacities (cubic feet)	630	780	520
Number of cubic feet of springs baked per 21-hour day (24 heats day and night)	15,120	.....	.....
Number of cubic feet of springs baked per day (30 heats in 10 hours)	.....	23,400	15,600
Number of cubic feet of springs baked per month (25 working days)	378,000	585,000	390,000
Number of gallons of fuel oil burned per month (25 working days)	.....	3,325	.....
Cost of fuel per month*	$225.00	$182.88	.....
Cost of fuel per cubic foot of springs baked*	$0.0006	$0.0003	$0.00028
Cost of fuel per month†	.....	$116.38	.....
Cost of fuel per cubic foot of springs baked†	.....	$0.0002	$0.00017
Saving in cost of fuel (spring capacity 378,000 cubic feet per month)	.....	$112.50	.....
Saving in cost of fuel (spring capacity 390,000 cubic feet per month)*	.....	.....	$124.80
Saving in cost of fuel (spring capacity 585,000 cubic feet per month)*	.....	$175.50	.....
Saving in cost of fuel (spring capacity 378,000 cubic feet per month)†	.....	$149.40	.....
Saving in cost of fuel (spring capacity 390,000 cubic feet per month)†	.....	.....	$167.70
Saving in cost of fuel (spring capacity 585,000 cubic feet per month)†	.....	$234.00	.....

Machinery

* Gas, 70 cents per thousand feet; fuel oil, 5½ cents per gallon.
† Gas, 70 cents per thousand feet; fuel oil, 3½ cents per gallon.

although within the same shell as the others, it is still an oven by itself. Compartments 1 and 2 only have a sheet metal partition *G* between them. This partition starts 18 inches above the floor and extends to the roof of the oven, so that these two compartments operate as one oven. This construction gives the oven a flexibility that will take care of any quantity of springs that may be ready to bake. All three compartments may be operated at the same time, two at one time, or one alone.

The japan baking outfit noted herewith may be considered as the equal of electric ovens, while the cost for fuel is about one-tenth and the installation about one-third that of the electric oven. Some of the good points of the system mentioned are quick baking, a neutral atmosphere, no air currents and

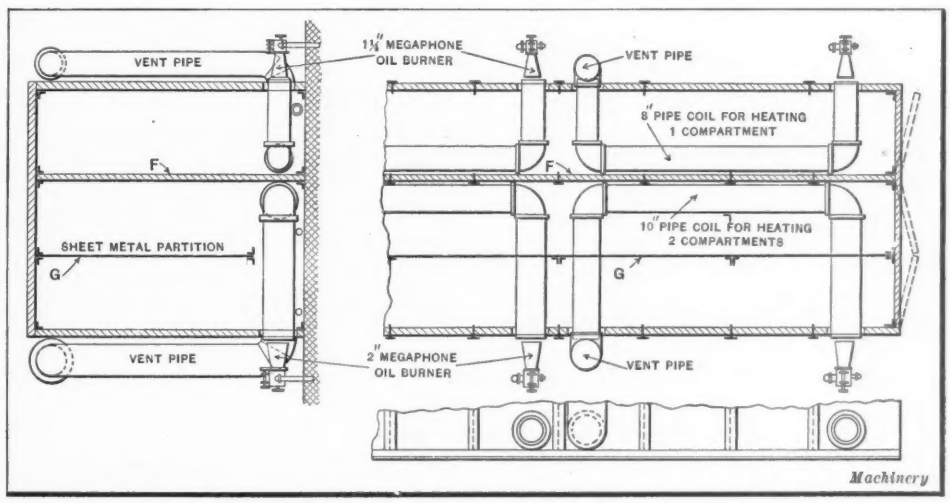


Fig. 10. Sectional View of Ovens, showing Method of installing Pipe Coils for Fuel Oil Heating

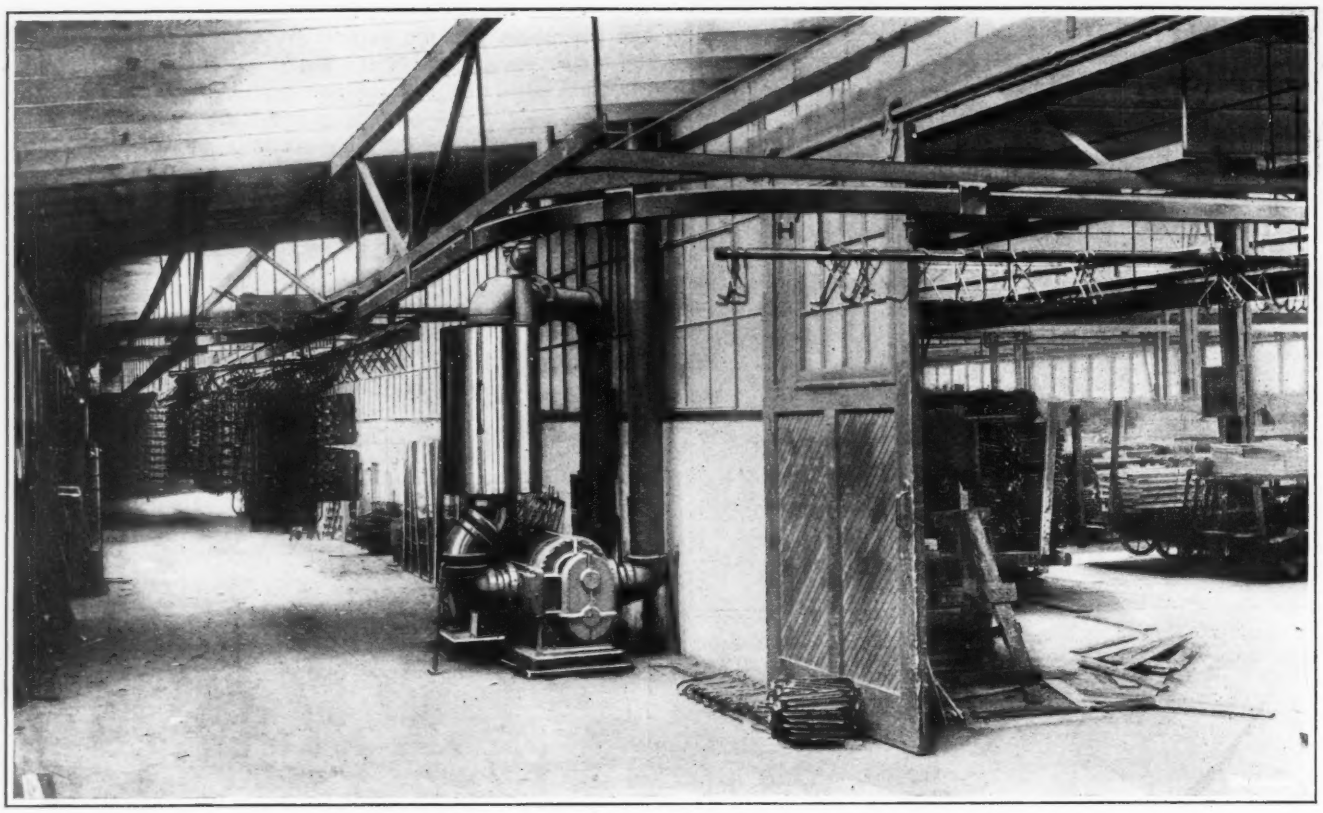


Fig. 11. View of Shipping Room, showing Point at which Empty Carriers return to be reloaded, and Oil Burning Power Plant

no products of combustion to attack the work. In citing a comparison of cost, let us take a group of radiator shells that were japanned and baked in an electric oven having a capacity of fifty-four shells. The electric current for baking three coats of japan costs twenty-one cents for each shell, or seven cents per shell for each coat. The electric ovens were replaced by an oven heated with illuminating gas, and the gas cost for baking the same three coats was five cents per shell, or less than two cents per coat. The cost for fuel in an oil burning oven would be less than one cent per shell for each coat of japan with fuel oil at the present war price of 5½ cents per gallon.

A tabulated comparison of costs between gas and oil fired ovens is illustrated in the accompanying table. The figures included in this table were obtained from the work done in the gas fired ovens operated in this factory during the month of January, and also from the work done in the oil fired ovens during the first twenty-eight working days after they had been installed. It seems probable that even better results than those shown in the table will be obtained when the workers have had more experience in handling the work and operating the oil burners. The saving will be greater when fuel oil returns to its nominal price, as the war price of 5½ cents per gallon was used in this tabulation.

Power Plant and Shipping Room

One side of the shipping room is shown in Fig. 11, the japanning outfit being in evidence at the far end and the springs hanging from the trolley waiting for the craters. The method of hanging the track from angle irons can be clearly seen at the point where the three-oven tracks merge into one, and empty spring carriers can be seen coming through the curve and switches at this point, while another one is moving through the doorway on its return to the inspector's benches to be reloaded. The power plant that delivers fuel oil to the megaphone burners and produces the air blast needed for its proper combustion can be seen in the center of the illustration against the wall. An electric motor, a No. 8 air compressor or blower and an oil pump are all located on one bed-plate. The oil pump is driven by a chain and sprocket from the blower shaft which is driven by the motor through a system of gearing. To shut down the baking oven, it is only necessary to pull the switch that starts the motor; then the oil at the burners all drains back to the storage tank. It is unnecessary to caution the workers to turn off the oil before they shut down the blower, as the plant is fool-proof in that respect. Explosions occur from neglect to turn off the fuel oil when the arrangement is such that the blower and oil pump are driven separately. Serious accidents, bad burns and fires have resulted from such explosions but these are entirely overcome by making the oil pump stop automatically when the air blast ceases.

* * *

PATCHING CONCRETE FLOORS

One of the principal objections often raised against the use of concrete finished floors is the difficulty and cost of successfully repairing places that have become worn or damaged. For best results it is usually considered necessary to cut down the worn place at least 1½ inch into the unbroken concrete, under-cut the edges, clean out the dust and loose particles thoroughly, wash with a thin cement grout, fill in with a paste grout and finally float to a level surface a mortar of cement and crushed stone or gravel. The patch must then be kept moist for at least a week or ten days, keeping all traffic off in the meantime.

W. P. Anderson, president of the Ferro Concrete Construction Co., states that his company often uses a method of patching concrete floors which is much cheaper and requires far less time than that commonly used. Mr. Anderson's method requires the use of a mastic material made from a mixture of asbestos fiber and rubber gum. This mixture is applied with a trowel after thoroughly cleaning the damaged surface. Very little cutting of the old concrete is necessary, other than to break off loose particles. The gum can be worked to a feather edge so that it will readily join with the undamaged concrete surface and eliminate the under-cutting required with the old style of patch. A patch of this sort can be opened to foot traffic within a few hours and to heavy traffic within a day or so. It is thus possible to repair a much-used portion of a mill or factory floor almost over night. The cost varies with the size of the patch but amounts to from sixteen to eighteen cents per square foot.

* * *

CORRECTION

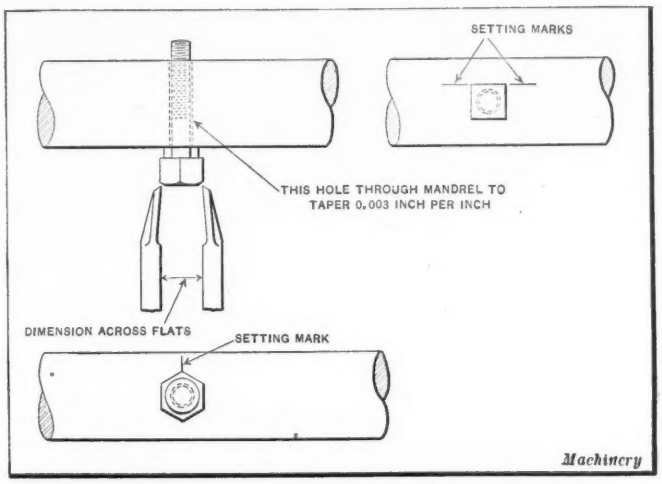
On page 885 of the June number of MACHINERY, the twenty-first line in the second column of the table reads 54 — 37 — 0.0602959. The number of teeth in the driven gear given as 37 should read 47.

LETTERS ON PRACTICAL SUBJECTS

We pay only for articles published exclusively in MACHINERY

FACING BOLT HEADS ON A LATHE

The accompanying illustration shows an ingenious method of facing square or hexagon bolt heads on a lathe. The bolt is held in a transverse hole in an arbor which is supported on the lathe centers, and index marks are provided for setting the head of the bolt to bring its faces in the desired relation to each other. As the diameter of stock bolts is likely to vary considerably, a taper hole is provided through the mandrel



Method of holding Square- and Hex-headed Bolts for facing on Lathe

to allow for this variation in size. This results in the heads of different bolts being located at various distances from the mandrel, and for this reason the bolt head is simply "sighted" on the index marks instead of employing a positive stop for locating different surfaces.

It will be evident from the illustration that two surfaces are faced at the same time by means of straddle tools, and the method of supporting the work is sufficiently firm to enable heavy cuts to be taken. After the arbor has been set up on the lathe centers, a bolt is placed in the transverse hole and driven lightly home by means of a lead hammer, the diameter of the mandrel being such that the point of the bolt projects about ¼ inch. The first cut is then taken, and when two surfaces of the head have been faced in this manner, the bolt is released by striking the point with the lead hammer, after which the finished faces are sighted on the index marks in order to locate the work for facing the next pair of surfaces on the head. It will be evident that two operations complete the work on a square bolt head, while three operations are required in facing a hexagon bolt head.

Plainfield, N. J. J. B. MURPHY

WHERE THE PROOF FAILS

On page 65 of MACHINERY'S HANDBOOK, under the title "Rapid Proof of Multiplication and Division," is given a method of proving the results of examples in multiplication by the digit system which is similar to the method of eliminating nines that I formerly used. This method never failed until one day I had occasion to convert 32.25 millimeters into the equivalent fraction of an inch, which I did in the following manner:

0.03937
32.25

19685
7874
7874
11811

0.1358265

It will at once be apparent that the result of the preceding calculation is incorrect, but according to the rule for checking the result given in MACHINERY'S HANDBOOK, we find: $3+9+3+7=22$, and $2+2=4$; $3+2+2+5=12$, and $1+2=3$. Then $3\times 4=12$; and $1+2=3$.

Carrying through the same process for the result of the preceding process of multiplication, we find: $1+3+5+8+2+6+5=30$, and $3+0=3$. This indicates a correct result.

0.03937
32.25

19685
7874
7874
11811

1.2696825

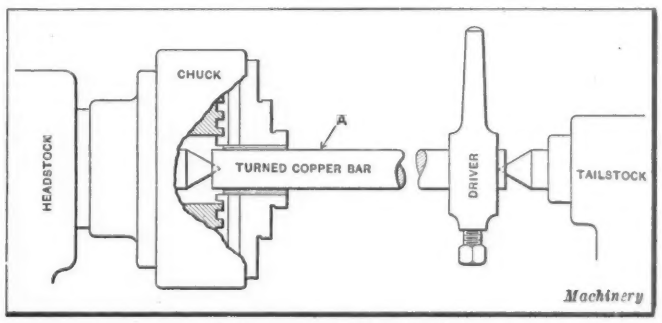
Adding the digits of the result of the preceding calculation which is correct, we find: $1+2+6+9+6+8+2+5=39$, and $9+3=12$, and $1+2=3$. Hence, the method of checking indicates that both results are accurate, while as a matter of fact the first is incorrect.

Brooklyn, N. Y. S. GOODMAN

[The method given on page 65 of MACHINERY'S HANDBOOK is based upon a proper arrangement of the work in performing the process of multiplication, and when the work is properly arranged the method is a reliable check on the accuracy of the result obtained.—EDITOR.]

TRUING JAWS OF SCROLL CHUCK

The method of truing up the inner gripping surfaces of scroll chuck jaws shown in the accompanying illustration has been found effective and much cheaper, quicker and more accurate than the use of an internal grinding attachment. If the jaws are trued up by an internal grinding wheel, they will be more or less slack during the truing process, and will probably run considerably out of truth when tightened onto the work. In using the method shown in the accompanying illustration, the live centers of the lathe must run perfectly true, and must not project beyond the inner face of the chuck jaws. The copper bar *A* must be turned cylindrical for a few inches near the headstock and a large driver must be attached to the tailstock. Over the turned length of the bar, carborundum powder and lard oil or some other equally good lapping compound should be evenly spread, taking care at the same



Truing Jaws of Scroll Chuck

time to keep the compound away from the live center. The chuck jaws may then be tightened so as to grip the bar lightly and the lathe started while the bar is prevented from turning by the driver.

As the lapping proceeds, the gripping faces of the jaws can be tightened up, adding a little kerosene and more lapping compound if necessary from time to time until the faces of the jaws have been properly trued. It is advisable to apply only light pressure to the jaws at first, but after the car-

borundum has been ground down fine, the work should be finished under the greatest pressure possible without absolutely gripping the lap. This is done to force the teeth of the jaws against the scroll of the chuck as firmly as possible, so there will be no backlash. Care must also be taken to see that the copper lap is held firmly between the lathe centers. As the lap can withstand considerable pressure, the work will be more accurate than when a grinding wheel is used.

Bradwardine, Bathurst, N. S. W. R. GORDON EDJELL

[It is evident that a copper bushing could be used in place of the solid copper bar if desired. The bar could be of steel and the bushing forced onto one end and turned in position, since the present cost of copper is high.—EDITOR.]

IMPROVEMENTS ON INTERMITTENT MOVEMENT OF GENEVA WHEEL

Inertia is an important factor in intermittent motion, especially when large masses are involved. In order to apply intermittent motion at all to such masses, ratchets or other devices are required, and these cause large friction losses without overcoming in any way the effect of inertia. The intermittent action of the regular Geneva wheel, which is efficient enough for small pieces, is impracticable in machines of such size that they require the movement of large and heavy masses under power.

Recognizing this difficulty and finding the necessity of applying an intermittent movement, the writer found it necessary to use a Geneva wheel, 8 inches diameter, to move masses weighing over 200 pounds at a velocity of 50 R. P. M. In this particular case the inertia effects were severe, tending toward the destruction of the machine unless counteracted in some way. In order to provide for this I designed the following device which has been used with excellent results.

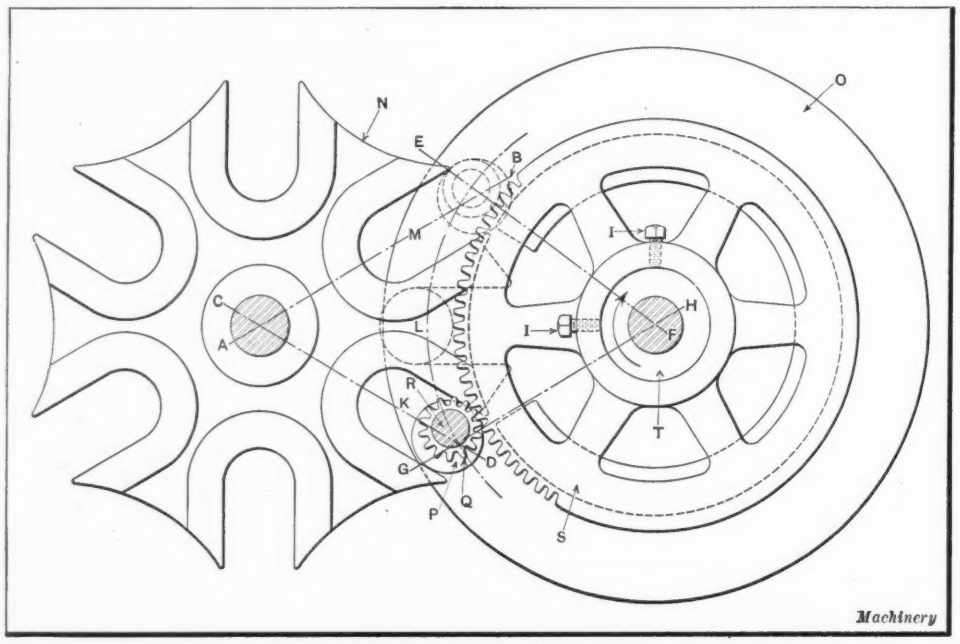


Fig. 1. Improved Movement applied to the Geneva Wheel

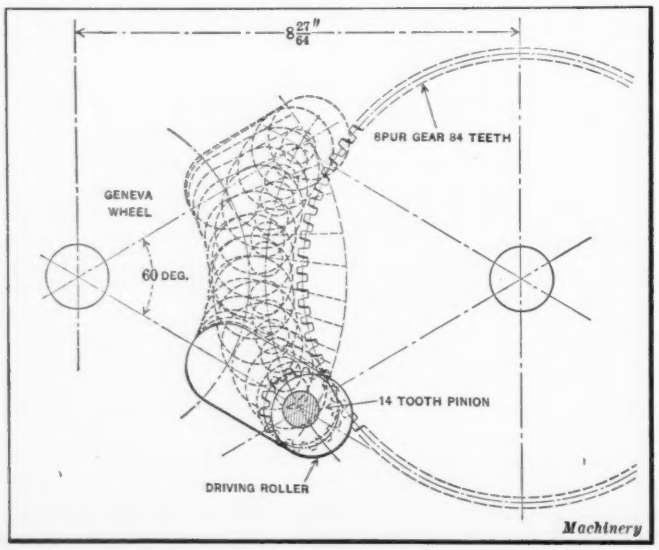


Fig. 2. Diagram showing Progressive Movement of the Geneva Wheel

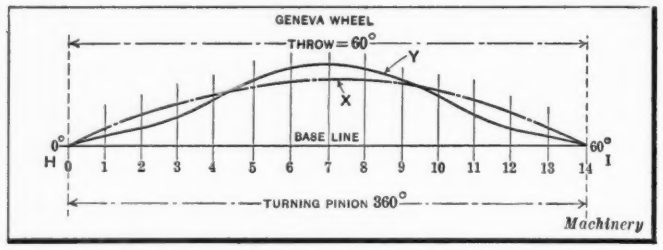


Fig. 3. Diagram showing Comparison in Movement of Regular and Improved Types of Geneva Wheel Operating Method

The point of connection between the driving roller and the Geneva wheel is placed at the points of intersection of the lines *AB*, *CD* and *EF*, *GH*, as indicated in Fig. 1. The driving roller is placed eccentrically with relation to these points of intersection, thus giving to the driver wheel different radii of leverage, which causes a gradual acceleration from the position *K* to *L*, diminishing in a similar manner from *L* to *M*. That is to say, the speed is slow at the beginning of the movement and gradually increases up to the half cycle, from that point diminishing gradually until the position *M* is finally reached. A curve representing the variations in speeds of the Geneva wheel when arranged in this way can be seen at *Y* in Fig. 3.

In order that the eccentric driving roll may make a complete revolution during the period of engagement with the Geneva wheel, it must be meshed with a stationary gear having a sufficient number of teeth in an arc of 60 degrees to produce one complete revolution of the roll.

In Fig. 1, *N* is the Geneva wheel, *O* the driver wheel, *P* the driving roll, *Q* a pinion gear attached to roll *P*, *R* the shaft bearing of *P* and *Q*, and *S* the spur gear which is held in position by the set-screws *I* on the bearing *T* of the driver wheel *O*. The gear pinion *Q* and the spur gear *S* always maintain the same relation radially, and the Geneva wheel moves 60 degrees for each revolution of the driver wheel, while the pinion and spur gear run together in the ratio of 6 to 1, the pinion having fourteen teeth and the gear eighty-four.

Referring to the diagram Fig. 2, the pinion and wheel can be noted in their fourteen positions, the graphic outline showing the path of the roll which accelerates up to the center, diminishing gradually thereafter in the same proportion until the end of the movement is completed. A comparison between the regular and improved Geneva movements can be noted in Fig. 3, in which *X* represents the uniform movement obtained by placing the driving roll concentric with the pinion, operating at a uniform radius, and *Y* represents the eccentric driving roll working at a variable radius. In working out this diagram, the line *HI* has been considered as representing a cycle of the driving roll in an arc of 60 degrees, alternating from 0 to 14 as shown by the position of each one of the fourteen teeth of the pinion in the driving roll during its complete cycle of 360 degrees. The principles involved in the mechanism described may be applied to many other cases where rapidity of movement and freedom from shocks are essential.

New York City. F. P. AMPUDIA

VARIATIONS OF PEAUCELLIER MOTION

The invention of the exact straight line motion by Peaucellier, an officer of the French army, gave an impulse to the study of the geometry of the straight line and circle; and students of modern geometry were not slow to recognize the value of this linkage as an illustration of the principle of inversion. The value of the mechanism in guiding a moving piece along a rectilinear path was at once apparent to the mechanical engineer; but it was reserved for the mathematician to discover the underlying principles of this combination of links.

Fig. 1 represents the arrangement of the Peaucellier linkage. It is composed of seven links moving about two fixed centers of motion *A* and *B*. The four equal links *E* form a rhombus; the links *F* are equal; and the center *B* is midway between *A* and *C*. If the point *D* be moved in the direction of the arrows, it is a simple demonstration in geometry to prove that it will be constrained to move in the straight path *D'D"*, which is perpendicular to the line of centers *ABCD*. This may be tested experimentally. The locus of the point *C* is the circumference *AC'C;* and the locus of *G* and *G'* is the arc described with the radius *F*. If the center line of the links *E* and *F* be assumed in any position such as *AC'D'* it will be found that the rhombus whose sides represent the length of the links *E* takes the position shown in the drawing.

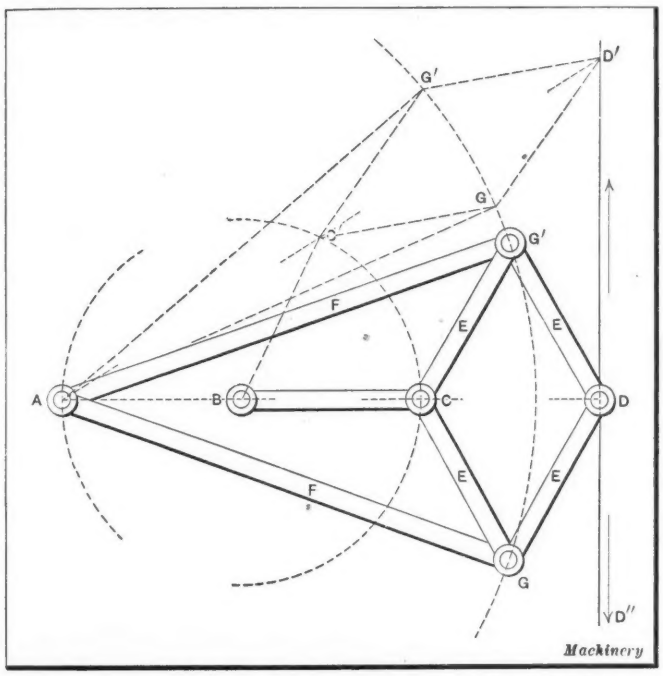


Fig. 1. Arrangement of Peaucellier Linkage for Straight Line Motion

In Fig. 1 the centers *A* and *B* are external to the links *E*.

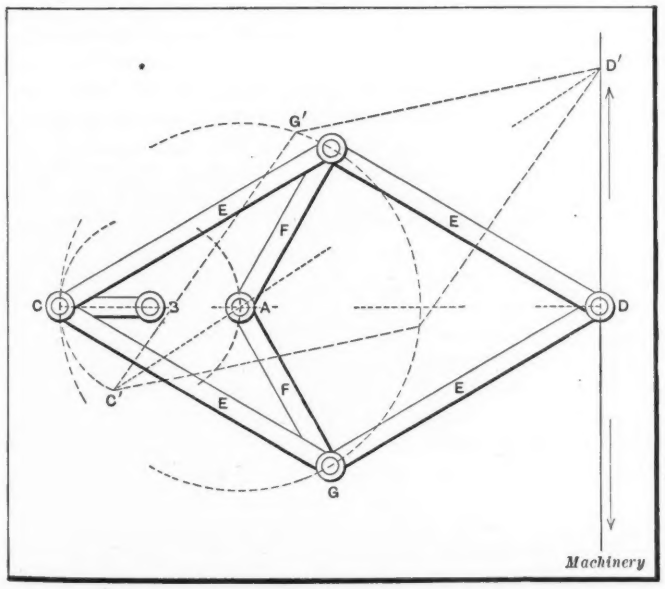


Fig. 2. Modification of Peaucellier Straight Line Mechanism shown in Fig. 1

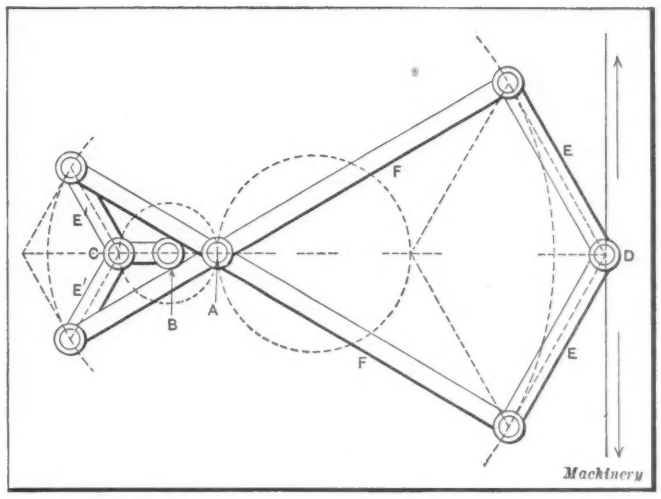


Fig. 3. A Third Arrangement of Peaucellier Straight Line Motion

A variation of the linkage is shown in Fig. 2, in which the centers *A* and *B* are within the rhombus. The links *F* are equal; and center *B* is midway between *A* and *C* as in Fig. 1. The corresponding links and points in the figures are labeled with the same letters; and it may be shown experimentally that the point *D* is compelled to move in a straight line perpendicular to the line of centers *CBAD*.

Fig. 3 shows another variation. On one side of the centers *A* and *B* are the two equal links *E*, and on the other side two equal links *E'*, which in each case form one-half of a rhombus

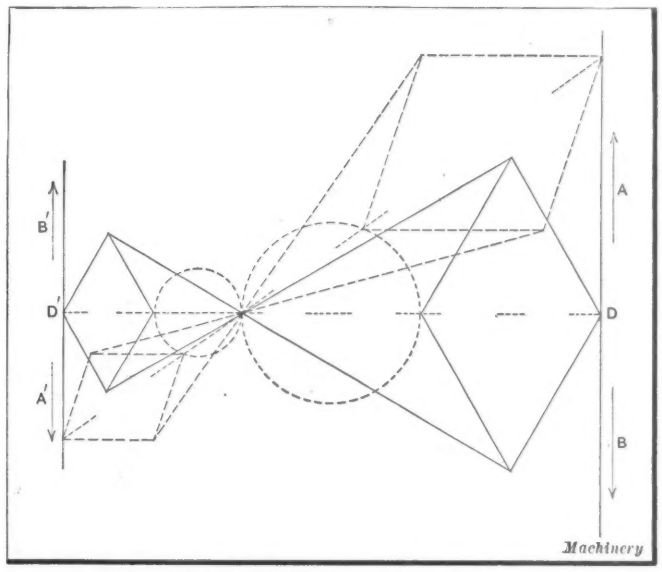


Fig. 4. Diagram showing Principle of Operation of Mechanism illustrated in Fig. 3

which is completed by the dotted lines. The equal links *F* are divided at *A* into segments which are in the same proportion as *E:E'*. The geometry of this arrangement of links is shown in Fig. 4. While the point *D* moves in the direction of the arrow *A*, *D'* moves in the opposite direction *A'*.

Hartford, Conn. FREDERIC R. HONEY

TURNING TAPER FITS

When using a compound rest to turn the taper fit in a piston and the correct taper has been obtained, the next step is to remove the work from the lathe and put the piston rod in place to see how it fits. Suppose it happens that the rod fails to go "home" by ½ inch; the method of procedure is as follows: Put the piston back in the lathe and set the tool so that it just scrapes at the end of the taper; next run the tool back 7/16 inch with the compound rest and then run the carriage forward the same amount. After this has been done, a finishing cut is taken without having used the cross-feed handle, and the amount of metal removed is such that the rod will come within about 1/16 inch of the desired posi-

tion. It can then be driven into place to secure a tight fit. For cases where the rod fails to enter by any other amount, the adjustment made with the compound rest will be in direct proportion, the idea being to leave a final 1/16 inch for the piston rod to be driven in to insure obtaining a tight fit.

Toronto, Ont., Canada. THOMAS MASON

GRINDING NARROW PARALLEL STRIPS

Recently, while I was walking through the shop, my attention was drawn to a method of finishing the edges of narrow parallel strips on a surface grinder. This consisted of stacking a number of blanks together and securing them with solder run along the ends, thus allowing the edges of several pieces to be ground at one time. In addition to saving time, this method allows the work to be turned over and ground on the opposite edges with the assurance that the two ground edges of each strip will be parallel. What struck me most forcibly was the fact that one of the first jobs I ever did on a surface grinder was similar to this one. I had to grind 200 pieces and did them one at a time, which was a very tedious piece of work. The thought that occurred to me was this: If the present method represents common practice, why did not my foreman tell me about it when he assigned me to that surface grinding job several years ago?

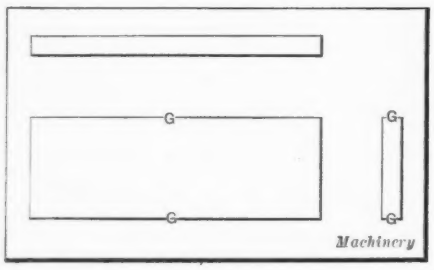


Fig. 1. Strip that had Edges ground Parallel

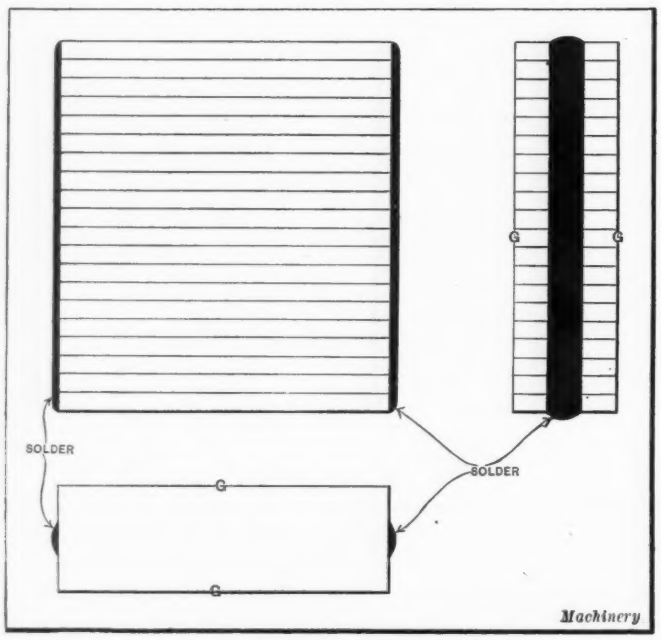
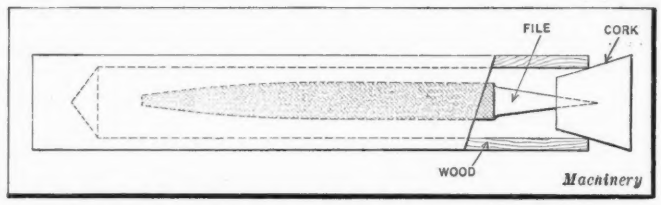


Fig. 2. Method of holding a Number of Strips with Solder while grinding Edges

SERVER

REMOVING CHIPS FROM TAPPED HOLES

While erecting or repairing machinery it is sometimes necessary to clean the chips out of tapped holes, and the deeper and smaller the hole, the more difficult it becomes to remove the chips. A very simple way of doing this is to have among your tools an old rat-tail file about ¼ or 5/16 inch in diameter, which has been strongly magnetized so that when the file is inserted in the hole all the chips will cling to it. In addition to its use for removing chips, this will be found quite a handy tool for picking up nuts, screws or washers which have been dropped into places where it is hard to get at them. If necessary, the file may be lowered on a string to reach places which would otherwise be inaccessible. Where such a file is used, however, care must be taken to keep it away from other tools to prevent them from becoming magnetized. For this purpose I took a round piece of wood and drilled a hole in it of suitable size to receive the file. Reference to the illustration will make it evident that this case is virtually a wooden bottle being provided with a cork to keep the file in place.

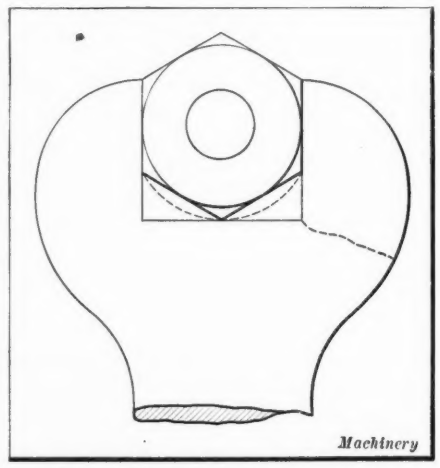


Wooden Case in which File is carried to prevent Other Tools from becoming magnetized

South Orange, N. J. WILLIAM PHILIP

IMPROVEMENT IN WRENCH DESIGN

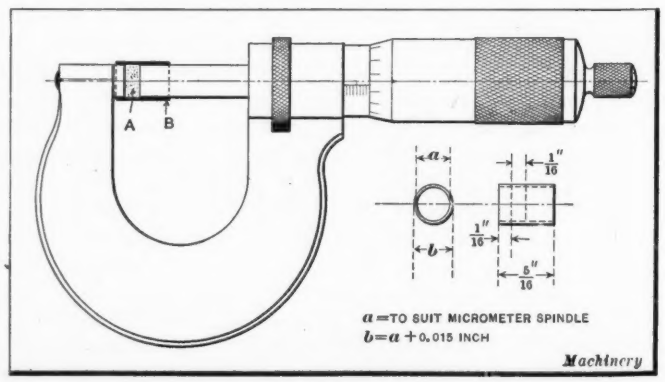
Despite their experience in the manufacture of S wrenches, there are still some manufacturers of these tools who persist in machining the openings with square corners. It will be obvious to any skilled mechanic that making a wrench opening of the form shown by the full lines reduces the strength to an unnecessary extent, because more than the required amount of metal has been cut away. The opening must be made deep enough so that opposite flats of a hexagon nut may be engaged by the jaws, but this result may be obtained with an opening of a form shown by the dotted lines, and such a wrench will possess considerably greater strength than one with square corners. N. G. NEAR



Wrench with Improved Form of Opening

COVER FOR MICROMETER SPINDLE AND ANVIL

In common with many other mechanics who frequently have occasion to use a micrometer, I always carry one of these tools with me, and have noticed that when I have to use it there is likely to be more or less grit between the anvil and spindle, making it necessary to clean off these surfaces before proceeding with my work. Occasionally the spindle becomes jammed down on the anvil in some mysterious way, and when this difficulty is encountered I usually find that the micrometer is "out" about 0.00025 inch, which makes it necessary to "set up" the spindle before the tool can be used. These



Cover for Micrometer Spindle and Anvil, with Cork Pad to prevent jamming Spindle down onto Anvil

troubles not only result in loss of time, but they also impair the accuracy of the tool.

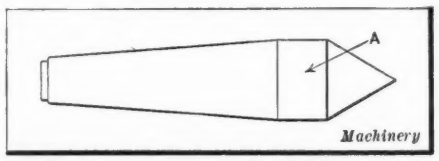
The attachment shown in the accompanying illustration entirely does away with annoyance from these causes, and it is so simple and easily made that it should be found of value by many mechanics. It is made of a piece of brass or copper rod bored to a nice push fit on the micrometer spindle and turned down on the outside to a diameter approximately 0.015 inch greater than the bore, so that the shell may be as thin as it is practicable to make it. After this work has been completed, a piece from 5/16 to 3/8 inch in length is cut off and finished on each end.

Next cut a disk of cork about 1/16 inch thick, which is pressed into the tube as shown at *A;* this disk should be a close fit in the tube and located about 1/16 inch from the anvil end. If the spindle fits properly into the bore of the tube, the application of a little oil will effectively prevent the contact surfaces of the micrometer from being damaged by grit or moisture; and the elasticity of the cork will prevent the micrometer thread from being strained through jamming the spindle down on the anvil. An advantage of this device is that it affords adequate protection and still leaves the micrometer ready for instant use without making the tool appreciably heavier.

Plainfield, N. J. J. B. MURPHY

IMPROVEMENT IN LATHE CENTERS

The illustration shows a method of grinding lathe centers to facilitate the subsequent work of lining them up. At the time the taper shank is ground, part *A* which projects beyond the spindle is also ground straight and parallel on both the head and tail centers; and care is taken to have the diameter of this cylindrical portion exactly the same on both centers. Then to line up the centers, an indicator or a tissue paper feeler is first applied to the head center, after which the carriage is run over to bring the indicator into contact with the tail center so that it may be adjusted to line up properly with the center in the headstock.



Lathe Center with Cylindrical Section A to facilitate lining up Headstock and Tailstock Centers

Jersey City, N. J. DONALD BAKER

COVERING A CONE PULLEY WITH LEATHER

Every machine shop that does a general business occasionally has a piece of work come in which taxes all the resources of the concern. A short time ago one of these jobs came into our shop, and as it was somewhat puzzling and required some study in order to work it out, it may be possible that the solution will help someone else out of a similar predicament.

We had a plain wooden cone pulley to cover with leather in order to keep a belt from slipping on it. This looks like a simple enough problem at first glance, and it seemed simple to me when I first attempted it, but as a matter of fact it did not prove to be as easy as it looked. The pulley in question was about 1 foot long and 1 foot in diameter at the large end. I was given a helper and told to go ahead with the work. I knew that a pattern could be laid out that would cover the pulley without trouble, but when it was laid out on paper as shown at *A* in the accompanying illustration, it was apparent that a great deal of material would be required. The helper said that he guessed it would take a whole side of leather and that there would be considerable difficulty in getting the superintendent to O. K. the bill. My next thought was that perhaps I might be able to get a strip of narrow belting and wind it tightly around the pulley and fasten it with tacks and glue, so that it would look something like *B* in the illustration.

We finally got hold of a piece of wide belting, the only thing of the kind which we could find around the shop that seemed anywhere nearly suitable for the job, and started on the work. At first there didn't seem to be any good way out of it, but after a little experimenting we got some heavy paper and cut it to the same width as the belting, and tacked it onto the pulley a little piece at a time until we covered the entire surface as shown at *C*. After this it was not a difficult matter to cut the belt to fit from the paper patterns. The pieces were then glued and tacked in place one at a time. When dry and trimmed up, the pulley made a very good appearance indeed.

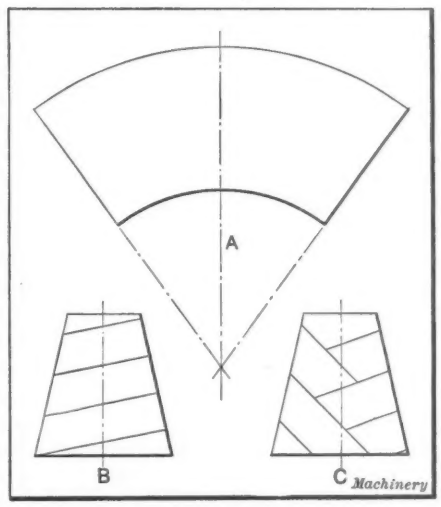


Diagram showing Method of covering Cone Pulley with Leather

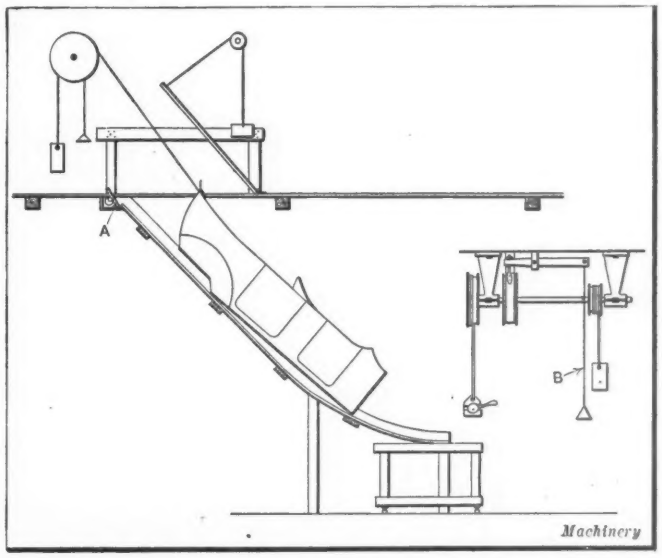
From the experience gained on this one matter, the writer has seen the folly of expressing an opinion before taking up a problem pretty carefully. The cone pulley was lagged in a satisfactory manner, but this point was of less importance than the realization that it is unwise to jump at a conclusion.

FRANK MCPHERSON

CHUTE FOR AUTOMOBILE BODIES

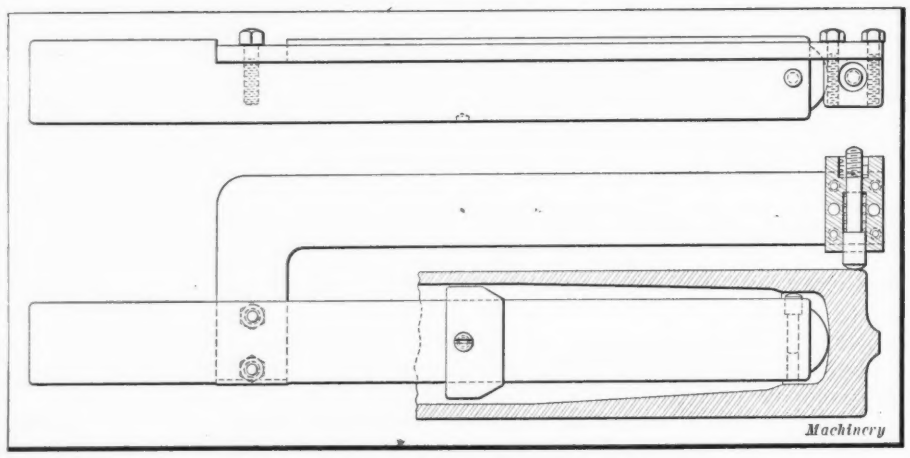
A labor-saving type of chute is used in the factory of a well-known automobile body manufacturer for transferring bodies in a partly finished condition to the floor below, where they are completed ready for shipment. A hole is cut in the floor through which the bodies are slid down a wooden chute covered with steel that is set at an angle of approximately 45 degrees. The chute is slightly curved at the bottom to avoid shock that would otherwise occur when the body strikes that point; and the bottom of the chute is located 30 inches from the floor level so that the bodies will slide onto trucks which are used to move them around during the performance of final operations in the process of manufacture. While on the upper floor of the factory, the bodies are pulled around on a small roller fastened to a block *A* which falls into the recess provided for that purpose when the body is tilted up ready to slide down the chute. A rope is secured to the rail on the body and the brake that controls the counterbalanced windlass allows the body to slide down easily. When the body has reached the bottom of the chute, a clamp is released and the rope is wound up automatically.

Two ordinary lineshaft hangers are set up with about



Chute for transferring Automobile Bodies to Lower Floor of Factory

4 feet of shafting between them; fastened on this shafting there are two pulleys, one of which is 18 inches in diameter and one 4½ inches in diameter. The rope that attaches to the body is wound around the large pulley and a counterweight rope is carried on the small pulley. The counterweight weighs just a little less than the body, allowing it to slide down the chute without the speed being accelerated too rapidly; and the action of this counterweight also causes the rope to be automatically wound up after it is released from the work. A brake drum which controls the downward movement of the body can be set to stop it at any desired point; to operate this device, the brake is released by pulling down on rope *B*, which allows the rope to unwind from the large pulley and drop the automobile body down the chute. When this chute is not in use the trap door is closed and locked; and a hand-rail is provided on all sides to prevent anyone slipping through. AUTO CRAFT



Device for testing Shell Forgings

ECCENTRICITY TESTING DEVICE FOR SHELL FORGINGS

One of the pitfalls into which many shell manufacturers have fallen to a greater or less degree is the expending of useless work on forgings that are so far out of round that when it comes to the finish-machining they will not "clean out." This trouble is due to the poor alignment of the forging tools from wear or improper setting.

The usual method of testing these forgings is to center the solid end, and mount the open end of the trimmed forging on a cone center; the shell is then checked when the roughing cut is taken. It is obvious that by this method considerable work is expended on every forging, whether it is true or not, and this cutting off to length, centering and turning wastes valuable time, if the shell is badly eccentric.

The accompanying illustration shows a forging testing device that has worked out satisfactorily in one of the largest shell manufacturing shops. It consists of a non-rotating arbor that is supported in a horizontal position by means of the stem end at the left. Supported from the rear end of the arbor is an arm that carries a spring plunger gage passing through a block and contacting with the shell forging. The end of the arbor is rounded to strike the bottom of the powder pocket. A gaging pin on the upper side of the arbor near the front end and a gaging ring at the rear end support the shell centrally. The shell is rotated by hand and any eccentricity is transmitted to the plunger gage. The upper end of the plunger gage is fitted with a pair of adjustable flanges, one of which acts as a check-nut for the other. The upper flange is so set that when gaging the lowest permissible point on the shell, the flange will be flush with the top surface of the gaging block. Therefore, whenever the flange drops below the top surface of the block, the operator knows he has a defective forging on the arbor and it is rejected.

The fixture is handled very rapidly, and an operator can gage many more shells than would be possible if these had to be mounted on centers previous to the actual testing. In addition, the forging may be tested before any work is done on the shell, and if it is eccentric it is thrown out at once without the expenditure of any labor upon it. C. L. L.

TABLE OF FRACTIONAL EQUIVALENTS TO NEAREST SIXTY-FOURTHS

Designers frequently have to reduce decimals to the nearest 1/64 inch, and the accompanying table was developed to facilitate doing this work. Its use does away with all guesswork and danger of mistakes. For instance, suppose it is required to reduce 0.333 inch to the nearest 64th; by referring to the table, we find 21/64 to be the required value. It will be seen that there are two decimal values after each fraction; the one directly opposite the fraction is its decimal equivalent; and in the third column, between each two decimal equivalents, is given the mean of these two values. This makes it an easy matter to determine rapidly the fractional equivalent of any given decimal to the nearest 1/64 inch. The use of the table will be made clear by solving another problem. Suppose it is required to find the value of 0.701341 inch to the nearest 64th. Reference to the table will make it evident that this value comes between 0.695313 and 0.703125 inch, so that 45/64 inch is found to be the desired result.

SAMUEL KAUFFMAN
Philadelphia, Pa.

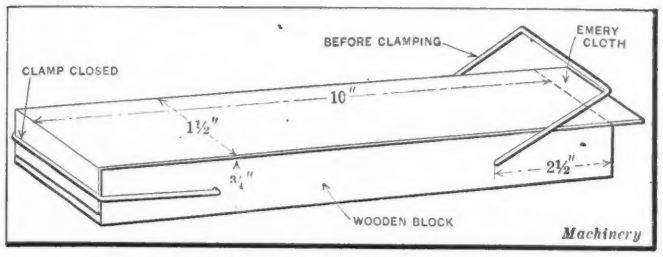
1/64		0.007813	17/64		0.257813	33/64		0.507813	49/64		0.757813
	0.015625			0.265625			0.515625			0.765625	
1/32		0.023438	9/32		0.273438	17/32		0.523438	25/32		0.773438
	0.03125			0.28125			0.53125			0.78125	
3/64		0.039063	19/64		0.289063	35/64		0.539063	51/64		0.789063
	0.046875			0.296875			0.546875			0.796875	
1/16		0.054688	5/16		0.304688	9/16		0.554688	13/16		0.804688
	0.0625			0.3125			0.5625			0.8125	
5/64		0.070313	21/64		0.320313	37/64		0.570313	53/64		0.820313
	0.078125			0.328125			0.578125			0.828125	
3/32		0.085938	11/32		0.335938	19/32		0.585938	27/32		0.835938
	0.09375			0.34375			0.59375			0.84375	
7/64		0.101563	23/64		0.351563	39/64		0.601563	55/64		0.851563
	0.109375			0.359375			0.609375			0.859375	
1/8		0.117188	3/8		0.367188	5/8		0.617188	7/8		0.867188
	0.125			0.375			0.625			0.875	
9/64		0.132813	25/64		0.382813	41/64		0.632813	57/64		0.882813
	0.140625			0.390625			0.640625			0.890625	
5/32		0.148438	13/32		0.398438	21/32		0.648438	29/32		0.898438
	0.15625			0.40625			0.65625			0.90625	
11/64		0.164063	27/64		0.414063	43/64		0.664063	59/64		0.914063
	0.171875			0.421875			0.671875			0.921875	
3/16		0.179688	7/16		0.429688	11/16		0.679688	15/16		0.929688
	0.1875			0.4375			0.6875			0.9375	
13/64		0.195313	29/64		0.445313	45/64		0.695313	61/64		0.945313
	0.203125			0.453125			0.703125			0.953125	
7/32		0.210938	15/32		0.460938	23/32		0.710938	31/32		0.960938
	0.21875			0.46875			0.71875			0.96875	
15/64		0.226563	31/64		0.476563	47/64		0.726563	63/64		0.976563
	0.234375			0.484375			0.734375			0.984375	
1/4		0.242188	1/2		0.492188	3/4		0.742188	1"		0.992188
	0.25			0.5			0.75			1.	

Machinery

Table of Fractional Equivalents to Nearest Sixty-fourths

EMERY CLOTH HOLDER

A friend of mine recently developed a handy method of holding emery cloth and has given me permission to pass the idea along to readers of MACHINERY. It is very simple



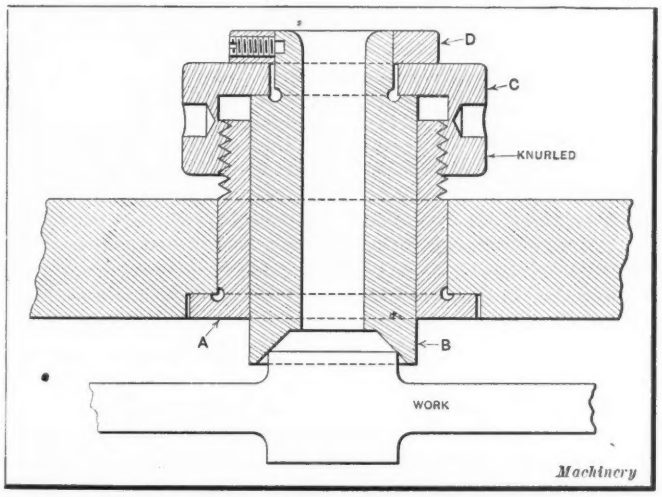
Block with Quick-acting Clamps for holding Emery Cloth

and is clearly shown in the accompanying illustration. Take a block of wood of about the dimensions illustrated—although the size will naturally depend upon the nature of the work—and instead of tacking the emery cloth on this block, secure it in place by means of bent wire clamps at each end. The emery cloth must be about 1½ inch longer than the wood, so that it may be turned down at the ends and overlapped sufficiently to be held in place. The emery cloth may be quickly removed when worn and a new piece substituted in its place.

N. G. NEAR

CLAMP BUSHING

The clamp bushing for drill jigs, shown in the accompanying illustration, occupies no more space than the screw type of bushing, and has many features which commend it to the favorable attention of tool designers. This bushing is fully



Compact Type of Clamp Bushing that can be operated by Hand or by a Wrench

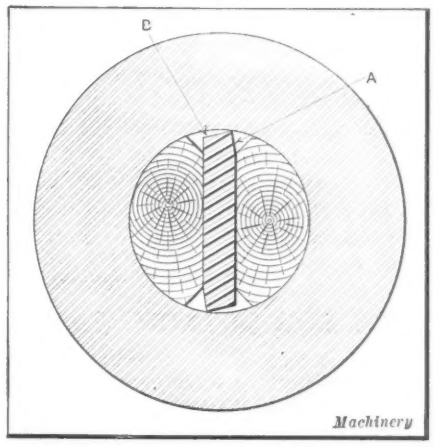
as efficient as the lever-operated type, which often cannot be used because of the amount of space which it occupies. It will be evident that a lining bushing *A* is provided, which has a collar at its lower end to prevent it from being pulled through the body of the drill jig when bushing *B* is forced onto the work by tightening knurled nut *C*. Thrust collar *D* is fastened to drill bushing *B* by small dog-pointed set-screws, and serves as a bearing for nut *C* when raising bushing *B* out of the work. Four spanner wrench holes are drilled in nut *C* to provide for the use of a wrench when more pressure is required to hold the work than can be provided by the knurled hand grip; and when so desired, the nut may be made hexagon shaped and operated by an ordinary wrench.

Cleveland, Ohio. R. J. KRUSE

MAKESHIFT TAPER REAMER

We had to ream a tapered hole on a rush job, and when the supply room was called upon for a reamer to handle the work it was found that the required tool was not in stock. There was just one No. 7 B. & S. taper hole to be reamed in a steel part, and it was out of the question to spend time waiting for a reamer to do the work. Accordingly, we made a makeshift tool out of an old file and secured very satisfactory results, both as regards fit and finish.

In making this special reamer the tapered end of an old 8-inch flat file was used; sides *A* and edges *B* were roughed out by hand on a grinding wheel, after which the tool was clamped in a vise on the shaper to enable edges *B* to be ground straight and true. An electrically driven toolpost grinder was mounted in the clapper box to provide for handling this operation; and after the grinding had been finished, the tool was sharpened with an oil-stone to obtain a keen edge and accurate finish. The tool was completed in less than an hour.



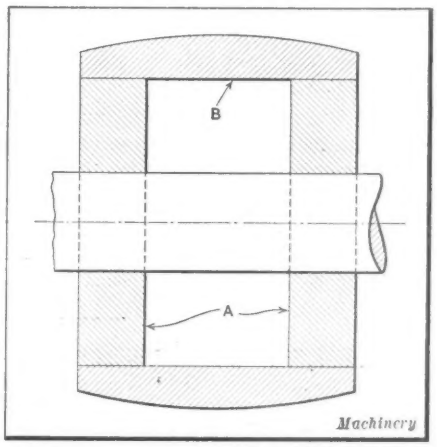
Makeshift Taper Reamer for Use on Repair Job

The accompanying illustration shows how this reamer was applied to the work; the file was left long enough at the back end to be engaged by a wrench, and feed was provided by the tailstock spindle. Soft wooden supporting wedges were driven in between the sides of the reamer and the steel bushing to provide firm support, and while in use the tool was flooded with oil. As previously mentioned, the results obtained were very satisfactory, the surface of the reamed hole being as smooth as glass and the taper quite accurate.

C. T.

METHOD OF REPLACING SMALL PULLEYS

During the past eight or nine years I have been employed in machine shop work; and in repairing small pulleys which have been broken, such as motor pulleys and the pulleys on emery wheel mandrels, I have obtained satisfactory results by turning the two hubs *A* from cast iron and shrinking onto them a piece of "double-strength" steel pipe *B* of the desired size for the pulley. After this part of the work has been completed, I start at the center of the piece of pipe and turn a taper to first one edge and then the other in order to form the required crown on the pulley. One of the first pulleys which I made in this way has been in constant use for a little more than three years, and is giving just as good service as the one which it replaced. A pulley can be made by this method in a very short time, and saves waiting for a casting to be made or ordering a pulley from an outside concern.



Substitute Pulley made of Two Cast-iron Plugs and Steel Pipe

Anamosa, Iowa. ALBERT PARKIN

* * *

A plain knee type milling machine with attachments will do all that a universal machine can do and is a simpler and stiffer machine. The swiveling table of the universal type is limited to an adjustment of about 50 degrees each side of the right-angle position, whereas a swiveling vertical attachment may be set at any angle. Many concerns buy universal machines when they could use the plain type with attachments and have a better machine for ordinary work.

HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

SPECIFYING HOLE SIZES

A. R. H.—There is a difference of opinion between the drafting-room and the factory on the following question: The drafting-room practice is to specify a reamed hole thus: "One-inch ream"; the factory practice is to use a standard one-inch plug gage to size the hole. Is the factory right in using the gage?

A.—We believe that the drafting-room should merely specify the size of holes that can be expressed in whole numbers and common fractions and leave the factory free to use standard plug gages to size the holes. If the drafting-room specifies a one-inch hole, it is up to the factory to make this hole one inch diameter, and there is no better means of determining the size of the hole than to test it with a one-inch standard plug gage.

DIES FOR CUTTING PAPER AND LEATHER

J. K.—I have seen many dies for cutting paper and leather made with sharp edges, while the punch was made with a square face. Recently, however, I saw a die for cutting paper that worked successfully, having a square face the same as the punch. Will you kindly tell me if this is coming to be common practice?

A.—Dies with square cutting faces are being used successfully for cutting paper, cardboard and leather. It is necessary to have a close-fitting punch and to keep the dies sharp. With a properly fitted punch and sharp die the resistance to cutting is no greater with a square-face die than with the old type of sharp-face die. The square-face die has a longer life, is simpler to make and less likely to be damaged in use.

UNIT OF ACCELERATION

A. J. C.—Why do some writers express acceleration as feet per second and others as feet per second per second? Which is right?

A.—Acceleration may be defined as increase (or decrease) of velocity in a unit of time. If the unit of time for velocity is one second and the unit of space is one foot, then the unit of velocity is one foot in one second, or one foot per second. If the unit of time for acceleration is also one second, then the unit of acceleration is one foot per second in one second, or one foot per second per second. If the unit of velocity were one mile per hour and the unit of time for acceleration were one second, then the unit of acceleration might be written one mile per hour per second. It is customary to use the same unit of time for both velocity and acceleration; hence, some authors write the unit of acceleration as one foot per second^2, or as abbreviated, 1 ft. per sec.^{2}. J. J.

LIMITS OF CYLINDER AND PISTON VARIATIONS

R. E. N.—Perhaps some reader of MACHINERY will be able to advise what is considered standard practice with reference to the limits of steam pistons and cylinders. Pistons are seldom made an exact fit in the cylinders, and the cylinders are seldom bored perfectly round and cylindrical. What are the maximum and minimum limits in diameter for a piston of the following sizes: 3, 4, 5, 6, 7, 10, 12, 14, 16, 18, 20, 22, 24 26, 28, 30, 36, 42 and 48 inches diameter? What is the permissible distortion of steam cylinders corresponding to the foregoing piston sizes? The character of the engine, no doubt, makes some difference in the permissible variation from standard, as, for instance, a high-speed engine may not require as close limits as a slow-speed engine. The permissible variation may differ for vertical and horizontal engines of the same class. Similar information applying to stationary internal combustion engine cylinders and pistons would be of value.

The questions are submitted to the readers for reply. Anyone who can furnish this information is invited to submit it, preferably in the form of a short article.

CHROMATIC SCALE PROGRESSION

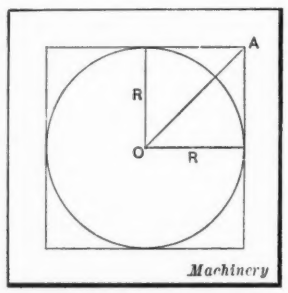
A. B. H.—What is the chromatic scale progression of speeds in machine tools, and how does the chromatic scale progression differ from the ordinary geometrical progression ratios of speeds?

A.—The so-called chromatic scale progression of speeds is merely a special form of geometrical progression in which the ratio is 1.4142, the square root of 2. If this ratio is too high, then 1.189 (the square root of 1.4142 or the fourth root of 2) is used instead. The advantage of the chromatic scale progression is that in the series the ratios 2, 4, 8, 16, 32, etc., appear. This makes it possible to have the back-gears of a lathe that is geared in the chromatic progression in an even ratio, such as 8 to 1. This is advantageous when quick-pitch screws are to be cut and the lathe is so arranged that the back-gears can be thrown in so as to drive the spindle while the lead-screw is driven direct from the cone pulley.

LARGEST BALL THAT CAN BE PUT BETWEEN ANOTHER BALL AND CORNER

H. T. O.—A ball 20 inches in diameter is placed in a cubical box measuring 20 inches on each edge (inside). If eight other balls are placed in the box, one in each corner, what is the greatest diameter of these balls and how is it calculated?

A.—Referring to the diagram, the circle represents the projection of the ball on the bottom of the box, and its radius is the same as the radius of the ball; the center O' is directly under the center of the ball. The distance $O'A$ is the hypotenuse of a right triangle; hence $O'A^2 = R^2 + R^2 = 2R^2$. The center O of the ball is at a distance R from O', and the line from O to A is the hypotenuse of another right triangle $OO'A$; hence, $OA = \sqrt{2R^2 + R^2} = R\sqrt{3}$, and the distance from the point where OA intersects the ball to the point A is $R\sqrt{3} - R = R(\sqrt{3} - 1)$. The center of one of the small balls must lie on the line OA and the distance from the point where it touches the large ball to the point A is evidently $r\sqrt{3} + r = r(\sqrt{3} + 1) = R(\sqrt{3} - 1) = 10(\sqrt{3} - 1)$, r being the radius of one of the small balls. Solving this equation for r, $r = 2.679485$ inches, and the diameter of one of the small balls is two times this, or 5.35897 inches. J. J.



Largest Ball that can be placed between Another Ball and Corner

HAND OF SPIRAL ON MILLING CUTTERS

O. W. M.—In making a number of taper-shank spiral teeth end milling cutters, the question came up as to whether the spiral of the teeth should be of the same hand as the cutter or the reverse. The advantages claimed for a right-hand spiral on a right-hand cutter are that the end teeth have a positive rake and that the chips tend to curl away from the end. The only advantage claimed for the left-hand spiral is that the pressure of the cut, being perpendicular to the face of the tooth, tends to drive the cutter back into the socket and does not tend to loosen and draw it out, as is the case with the right-hand spiral. The disadvantages of the left-hand spiral are that the finish of the work is very rough and the corners of the teeth break easily, both of which I believe are due to negative rake of the end teeth and to the fact that the chips flow to the front end of the cutter, thereby choking it. My experience has led me to believe that the advantages of the right-hand spiral more than offset the tendency to draw out, which is very slight if the cutter is driven firmly into its socket as it should be. An examination of a large number of cutters in the tool-room showed that there were three or four times as many left-hand spiral cutters with broken corner teeth as there were right-hand cutters. It would be interest-

ing to know the opinion of MACHINERY'S readers who have had experience with small tools.

A.—Manufacturers of end-mills, as a rule, use a left-hand spiral for right-hand milling cutters and a right-hand spiral for left-hand cutters, notwithstanding that the practice produces inefficient cutting tools. The fact that the left-hand spiral on a right-hand mill tends to push the cutter firmly into the socket is generally considered to outweigh the disadvantages mentioned. This applies, of course, only when the cutter is used for milling slots and a considerable number of the axial teeth are engaged. If the mill is used as an end cutter only, then the spiral on the right-hand cutter should be right-handed, because the teeth can be given a positive front rake. Some manufacturers of milling cutters prefer end-mills with teeth cut straight for ordinary use, in order to avoid the difficulties due to either the right-hand or left-hand spirals. Discussion of the subject is invited.

HORNER'S METHOD

C. J. B.—Will you please explain, step by step, Horner's Method, which is referred to by J. J. in the How and Why section of the July number of MACHINERY?

A.—A detailed description of Horner's Method would require more space than the editor feels able to spare. The method is fully treated, however, in the following works: "Theory of Equations," Vol. 1, by Burnside and Panton; "Theory of Equations," by Todhunter; and "University Algebra," by Olney. These are all quite advanced works, particularly the first two. It may be remarked that Horner's Method is conceded by practically every authority to be the best general method for solving numerical algebraic equations. J. J.

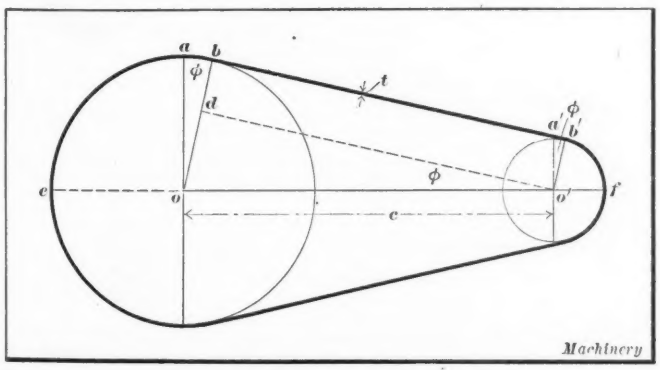
FORCE OF A BLOW

E. M.—I wish to secure the effect of a freely falling weight of 4 ounces dropping 6 inches, when the weight is attached to an arm 8 inches long. In other words, what effect will the attachment of the weight to a pivoted arm have on the velocity and force of the blow, supposing the pivot to be frictionless?

A.—The formula for determining the force of a blow is $ft = mv$, in which f is the force of the blow, t, the time required to bring the body to rest, m, the mass of the body, and v, the velocity at impact. Since it is not usually possible to measure t, the force of a blow is generally calculated by using the principle of work, as explained on pages 278 and 279 of MACHINERY'S HANDBOOK. The velocity is determined solely by the height through which the body falls, and is independent of the path it takes. Hence, the velocity will be the same when the weight moves along the path of an arc of a circle as when it falls freely, provided the height of the fall is the same. The only effect that the attaching of the arm to the weight will have on the force of the blow is that the mass moved is greater; therefore, the rebound will be less, and the penetration will be greater. The striking force will also probably be somewhat greater. J. J.

LENGTH OF OPEN BELT

S. C. J.—Will you please show me how the formula for the length of an open belt, given on page 722 of MACHINERY'S HANDBOOK, is derived?



Length of Open Belt

A.—This formula may be derived in several ways, but the writer prefers the following, as it leads to more accurate results. Referring to the diagram, the angles aob, $a'o'b'$, and $do'o$ are evidently equal, and may be represented by ϕ.

Let D = diameter of large pulley;
d = diameter of small pulley;
R = radius of large pulley;
r = radius of small pulley;
c = distance between centers of pulleys;
L = length of belt.

Then $L = 2(ea + ab + bb' + b'f)$

$$= 2\left[\left(\frac{\pi}{2} + \phi\right)R + \left(\frac{\pi}{2} - \phi\right)r + c\cos\phi\right] \text{ when the angles are expressed in radians}$$

$$= \frac{\pi}{2}(D + d) + \phi(D - d) + 2c\sqrt{1 - \sin^2\phi}.$$

Letting $S = D + d$, $s = D - d$, $S = 2D - s$, and $\sin\phi = \frac{s}{2c}$; the last expression then becomes:

$$L = \frac{\pi}{2}S + s\phi + 2c\sqrt{1 - \left(\frac{s}{2c}\right)^2}$$

From trigonometry:

$$\phi = \sin\phi + \frac{\sin^3\phi}{6} + \frac{3\sin^5\phi}{40} + \text{etc.};$$

hence $\phi s = \frac{s^2}{2c} + \frac{s^4}{48c^3} + \frac{3s^6}{1280c^5} + \text{etc.}$

By the binomial formula:

$$2c\sqrt{1 - \left(\frac{s}{2c}\right)^2} = 2c - \frac{s^2}{4c} - \frac{s^4}{64c^3} - \frac{s^6}{512c^5} + \text{etc.}$$

Substituting these values (and also $2D - s$ for S) in the last expression for L, and letting $\frac{s}{c} = a$, we obtain, after reduction:

$$L = \pi D + 2c - \frac{c}{2}\left(\pi a - \frac{a^2}{2} - \frac{a^4}{96} - \frac{a^6}{1280} - \text{etc.}\right) \text{ or}$$

$$L = \pi D + 2c - \frac{s}{2}\left(\pi - \frac{24sc}{48c^2 - s^2}\right) \text{ very nearly.} \qquad (1)$$

The term s^2 in the denominator is small compared with $48c^2$; if it be dropped and s be replaced with its equal $D - d$, Formula (1) will reduce to:

$$L = \frac{\pi}{2}(D + d) + 2c + \frac{(D - d)}{4} \qquad (2)$$

which is the same as the formula in MACHINERY'S HANDBOOK, when $3\,1/7 = 22/7$ is substituted for π. Neither formula is quite exact, because the thickness t of the belt has been neglected; if this be also considered, D must be replaced by $D' = D + t$. Formula (2) will give results sufficiently correct for ordinary purposes; but for extreme cases, when $n = \frac{D}{d}$ is large and c is small, Formula (1) should be used. For example, suppose $D = 15$, $d = 3$, and $c = 24$; then, neglecting t, $L = 77.78230 -$; by Formula (1), $L = 77.78219 -$; and by Formula (2), $L = 77.78571 +$. As will be observed, Formula (2) is sufficiently exact for all practical purposes. J. J.

TO CALCULATE THE FIFTH ROOT OF A NUMBER

R. J. B.—Please show me how to calculate the fifth root of a number. I wish a method that does not require the use of an extensive table.

A.—The extraction of the fifth root is always a long and laborious operation, and the writer prefers Horner's method to any other; a full description is too long to give here. As an alternative, the following may be used: Let r = the root to be found; m = the given number; n = the index of the root, so that $r = \sqrt[n]{m}$; then, if x = an approximate value

TABLE OF FIFTH POWERS

x	x^5	
1	1	4.3
2	32	80
3	243	475
4	1024	1735
5	3125	4830
6	7776	11265
7	16807	23200
8	32768	43600
9	59049	76300
10	100000	

Machinery

of r, $r = \left(\frac{m}{x^n} + n - 1\right)\frac{x}{n}$, approximately; and when $n = 5$, $r = \left(\frac{m}{x^5} + 4\right)\frac{x}{5}$, approximately. When $x = r$, $x^5 = r^5 = m$, and the equation reduces to $r = r$, as it should. To apply the formula, first compile a table giving the fifth powers of the numbers from 1 to 10, as shown herewith. The remaining steps are best explained by means of an example; thus, what is the fifth root of 12045.63? By reference to the table, it is seen that the first figure of the root is 6, since 6^5 is less and 7^5 is greater than $12045.63 = m$. By reference to the third column, it is seen that m is greater than 11265; hence, use 7 for x. Had m been less than or equal to 11265, 6 would have been used for x. Now substituting in the formula, $\left(\frac{12045.63}{16807} + 4\right)\frac{7}{5} = 6.60$, to two decimal places. Repeat the process, substituting 6.6 for x, obtaining $\left(\frac{12045.63}{6.6^5} + 4\right)\frac{6.6}{5} = 6.550-$, to three decimal places. Repeat the process once more, substituting 6.55 for x, obtaining $\left(\frac{12045.63}{6.55^5} + 4\right)\frac{6.55}{5} = 6.548860+$. The exact root to eight decimals is 6.54886293 —.

The number of figures to which any approximate root is correct can always be determined from the quotient of m divided by x^5 by multiplying the number of 9's at the extreme left of the quotient by 2, adding 1 if the figure following the last 9 is greater than 4. In the first case above, the quotient is 0.72 —; there are no 9's, but the first figure is greater than 4; and the root is therefore correct to $0 + 1 = 1$ figure. In the second case, the quotient is 0.962 —; here there is one 9, and the figure following being greater than 4, the root is correct to $1 \times 2 + 1 = 3$ figures. In the third case, the quotient is 0.99913; here there are three 9's, and the figure following the last 9 being less than 5, the root is correct to $3 \times 2 = 6$ figures. If the number is wholly decimal, multiply it by 100,000 and then divide the root by 10; if the number is greater than 100,000, divide it by 100,000 and then multiply the root by 10. Note that $100{,}000 = 10^5$. While the table of fifth powers is not strictly necessary, it is of great assistance. The formula may be used for any root. Thus, for cube root, $r = \left(\frac{m}{x^3} + 2\right)\frac{x}{3}$, approximately. J. J.

TO FIND THE MAXIMUM BENDING MOMENT OF A BEAM

M. A. P.—I enclose a sketch showing a simple beam AB, 25 feet long, which carries a uniform load (including its own weight) of 32 pounds per foot and several concentrated loads distributed as shown. Please show me how to find the maximum bending moment.

A.—It is necessary first to find the reactions of the supports. Denote the reaction of the left support by R_1 and that of the right support by R_2, and take the left support as the center of moments. Noting that the entire weight of the uniform load is $25 \times 32 = 800$ pounds and that the center of gravity is midway between the supports, or 12.5 feet from each, we have: $25R_2 = 800 \times 12.5 + 250 \times 2 + 150 \times 5 + 400 \times 9 + 200 \times 16 + 350 \times 22 = 25{,}750$; whence $R_2 = 1030$ pounds. Taking R_2 as the center of moments, $25R_1 = 800 \times 12.5 + 350 \times 3 + 200 \times 9 + 400 \times 16 + 150 \times 20 + 250 \times 23 = 28{,}000$; whence $R_1 = 1120$ pounds. Next, add successively, and in order, the various uniform and concentrated loads until the sum equals or exceeds the left reaction $R_1 = 1120$ pounds, as shown.

$32 \times 2 = 64$, 250, 314, $32 \times 3 = 96$, 410, 150, 560, $32 \times 4 = 128$, 688, 400, 1088, $32 \times 7 = 224$, 1312

Note that there are three concentrated loads between the left support and that point on the beam where the sum of the loads on the left of the section at that point is equal to $R_1 = 1120$. The sum of these three loads is 800 pounds; subtract this sum from R_1, obtaining $1120 - 800 = 320$. Now divide this result by the weight of the uniform load per foot, obtaining $320 \div 32 = 10$ feet = the distance from the left support to the dangerous section, marked x in the illustration. The maximum bending moment is then equal to (taking n as the center of moments) the moment of the left reaction minus the moments of all loads on the left, or $M = 1120 \times 10 - 32 \times 10 \times \frac{10}{2} - 250 \times 8 - 150 \times 5 - 400 \times 1 =$ 6450 pound-feet = 77,400 pound-inches.

That this method is correct is easily shown. Thus, draw the vertical line am through the point of left support, and on this line (to any convenient scale) lay off $ar = R_1$ and $rm = R_2$; the line am is called the load line. On this line, lay off a–1 $= 32 \times 2$ (the first section of the uniform load), 1–2 $= 250$ (the first concentrated load), 2–3 $= 32 \times 3 = 96$ (the second section of the uniform load), 3–4 $= 150$ (the second concentrated load), and so proceed until all the loads have been laid off. Through the points where the various loads are concentrated on the beam, draw vertical lines, as shown, and through the points 1, 2, 3, etc., on the load line, draw horizontal lines intersecting the vertical lines in the points b, c, d, etc. Connect these points by the broken line *abcdefgthijkl;* this line is called the shear line. Through the point r, draw the horizontal line *rs;* this line is called the shear axis. In works treating of the strength of materials, it is shown that the dangerous section occurs where the shear line crosses the shear axis; in this case it would pass through the point t in the diagram and the point n on the beam, which lies on the vertical through t. From the method of construction, it is evident that ab, cd, ef, etc., are parallel. Produce hg until it intersects the load line in g'; then the triangles $a1b$ and $g'rt$ are similar right triangles, and $\frac{b1}{1a} = \frac{tr}{rg'}$, or $tr = x = \frac{b1 \times rg'}{1a}$. But, $b1 = 2$, and $1a = 64$; hence, $\frac{b1}{1a} = \frac{2}{64} = \frac{1}{32}$, the reciprocal of the uniform load per foot. Finally, rg' is evidently the uniform load from A to the dangerous section at n. J. J.

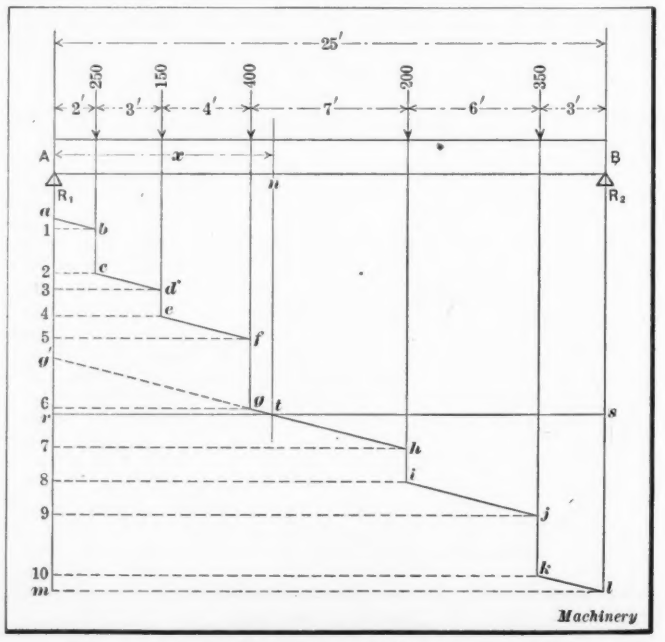


Diagram for calculating Maximum Bending Moment of Beam

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

FRASER UNIVERSAL CONVERTIBLE GRINDING MACHINE

The Fraser grinding machine meets the demand for a small universal grinding machine to handle cylindrical, internal, and surface work. The feed mechanism of the machine is accessible and the entire table control mechanism may be removed in a unit by the withdrawal of six screws. By means of the improved table reverse mechanism, a table stroke as short as one-half inch may be obtained.

The Warren F. Fraser Co., Freeport St., Boston, Mass., has developed and put on the market the universal grinding machine shown in Figs. 1 and 2. This machine is designated as the No. 1 size and can be used as a cylindrical grinding machine for handling work up to 8 inches in diameter and 20 inches in length; as an internal grinding machine for work up to 8 inches outside diameter; and as a surface grinding machine for handling work 5 inches wide and 20 inches long.

As is shown in Figs. 1 and 2, the base is of box type and is very broad to afford adequate support for the working parts

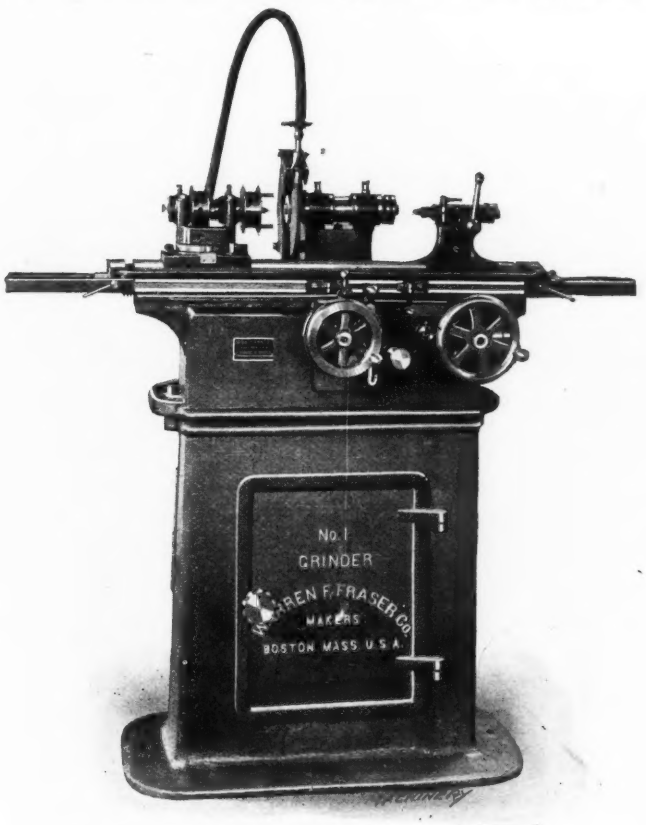


Fig. 1. Fraser Universal Grinding Machine—Front View

of the machine. The three-point principle is employed for supporting the upper part of the machine. A feature of the machine is the unit construction of the apron that permits all the feed mechanism to be taken out as a unit by removing six cap-screws that attach this apron to the front of the machine. Figs. 3 and 4 illustrate the apron and its mechanism removed from the machine. The lubrication of the apron shaft is effected through oil pipes that run from the apron plate to the various shaft bearings, as indicated in Fig. 4. Those shaft bearings that run at high speed are hardened and ground and run in bronze bushings.

Headstock and Tailstock

The headstock is of the swivel base type and can be set at any angle in a horizontal plane. It is graduated to give any reading from 90 degrees on one side of the center to 45 degrees on the opposite side. Both headstock and tailstock have a liberal length of bearing on the table. The headstock spindle is of bessemer steel, carbonized, hardened and ground at all points except the thread diameter. The taper seats for the centers are also ground in the headstock and tailstock. The headstock spindle runs in bronze boxes, the front one being a double angle bearing—5 degrees and 45 degrees—thus providing adjustment for wear. The rear headstock bearing is a solid bronze bushing which, considering the low speed at which the work-spindle runs, amply takes care of the bearing needs. The wheel-spindle can carry wheels up to 8 inches in diameter and ½ inch face, and it will be noticed that the spindle is double-ended so that the wheel may be mounted at either end. The wheel-head may be swiveled to any angle on the slide regardless of the position of the slide and its base. This is graduated to 45 degrees on each side of a right-angle position. The tailstock spindle is hardened and ground and is provided with a No. 1 Morse taper for the tail-center. The tailstock is provided with a spring center and a lever binder.

The wheel-head bearings are wick-oiled, and the oil is inserted in the oil-cup at the top and runs down to the bottom and into a reservoir; from there it is fed to the contacting surfaces by wicks that preclude the admission of grit to the actual bearing surfaces. The spindle adjustment for the bearings is made by turning collars on the ends of the bearing bushings, bringing them together and adjusting both bearings at the same time.

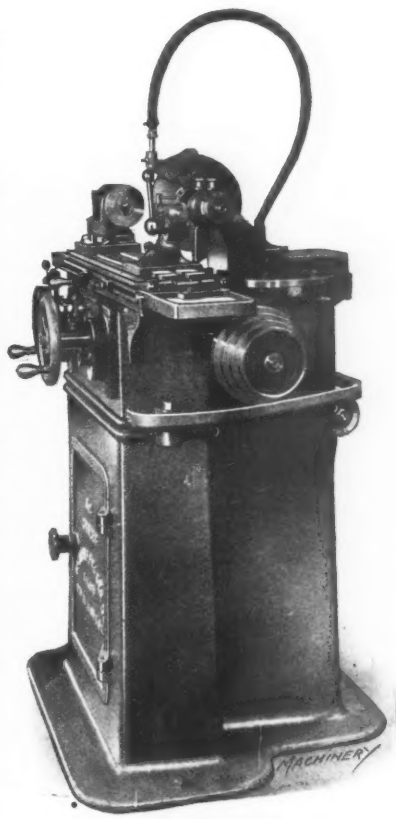


Fig. 2. Fraser Universal Grinding Machine—Side View

Table Controlling Mechanism

The table swings upon its bearings on the carriage about a hardened and ground spindle stud. An eccentric binding screw at each end of the table holds it in any desired position. The end scale is graduated to provide settings at angles up to 70 degrees each side of the center and for grinding any taper up to 2 inches per foot. A screw adjustment is provided.

The working surface of the table is 5¼ inches wide and 32 inches long, not including the surface outside of the waterways at the end, which if included, gives a total length of 36 inches. The working surface has a central part 3½ inches wide, and is raised ⅜ inch above the table proper. The headstock and tailstock are lined against the front edge of this raised surface. A single T-slot furnishes the means of attaching headstock, tailstock, center-rest and surface grinding chuck. At the front face of the carriage are the dogs that limit the length of the grinding stroke. The ways on which the carriage runs are of V type, and are 35 inches long and spaced 5½ inches apart. The carriage has long extension

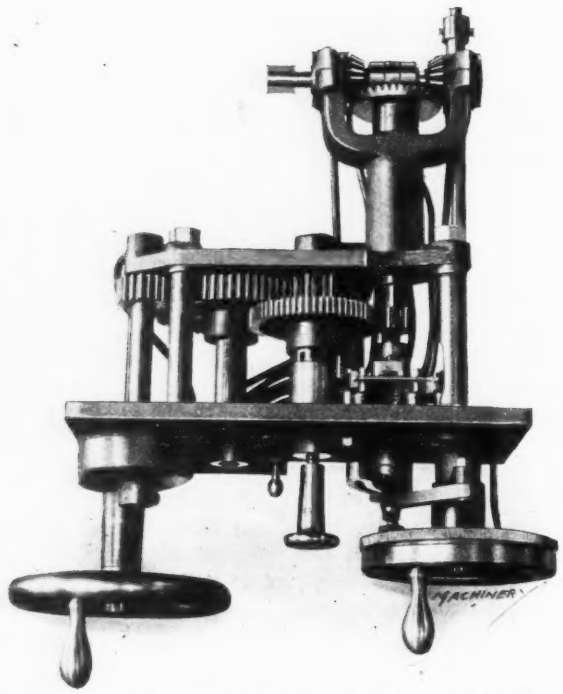


Fig. 3. Apron Unit, comprising Entire Mechanism of Table Control

ends that overhang and protect the ways at all points of the travel.

All the movements of the carriage are controlled by the single apron unit attached to the front of the bed. All the operating mechanism for the various table movements is therefore contained in a unit and entirely enclosed in the frame of the machine. Rack and pinion operated mechanism is used for reciprocating the table, and this, as well as the automatic cross-feed mechanism and the reversing mechanism, is controlled directly from the apron. The "load and fire" mechanism for the reversal of the table is very accurate and changes the direction of travel within a minimum length of ½ inch, so that if necessary, a ½ inch longitudinal travel of the table may be given. There are four changes of table travel provided, giving from four to thirteen feet travel per minute. By referring to the side elevation of the machine shown in Fig. 2, it will be seen that there is a four-step cone on the drive-shaft that provides for the different table feeds and speeds. The work-spindle is provided with speeds ranging from 60 to 150 R.P.M. through the countershaft. The wheel-spindle may be operated at 2750 or 3850 R.P.M. as desired.

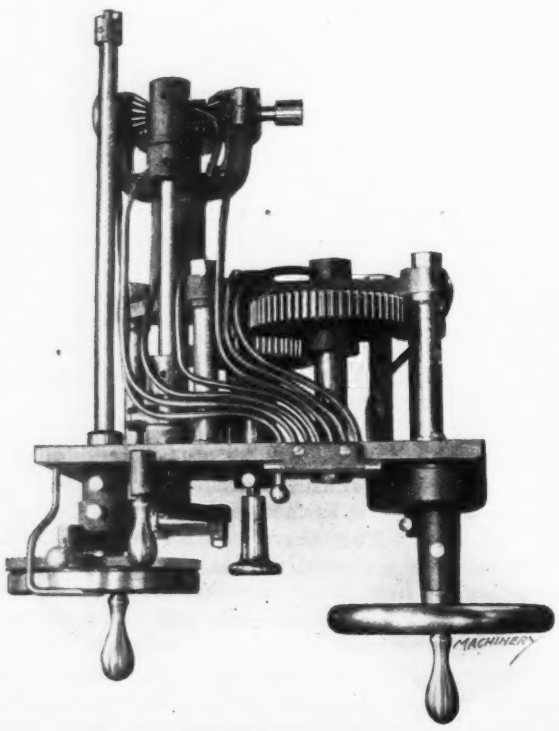


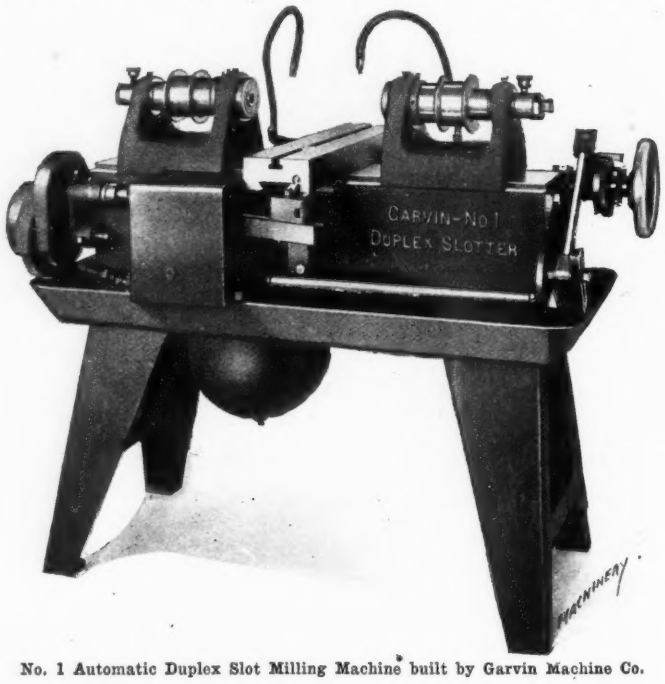
Fig. 4. Lubricating System for Apron Unit

An automatic cross-feed is provided for the wheel-head that may be adjusted to give as low a feed as 0.00025 inch per table stroke. Lubrication for the work while in operation is secured from a water pump in the tank at the left-hand side of the machine at the rear. The approximate weight of the machine is 1500 pounds without countershaft, surface or internal attachment; the shipping weight of the machine complete is about 2700 pounds.

GARVIN NO. 1 DUPLEX SLOTTING MACHINE

In operating the full automatic duplex slotting machine which forms the subject of the following description, it is only necessary to put the work in place, after which the machine will complete the operation without requiring further attention and stop cutting when the work is finished. A wide range of operations can be handled, among which may be mentioned milling in steel or other materials, slots from ¼ inch to 4 inches long by ¼ to 1½ inch in width right through work up to 4 inches in diameter. Among the classes of work for which the machine is adapted are cutting drift holes in drill press spindles, slots in toolposts, keyways, elongated holes or slots in castings, taking mortising cuts, and a great variety of similar operations. Working from both sides at once, machining is done in half the usual time; two pieces can be handled at the same time without extra effort on the part of the operator. The work is done much faster than by the method of jig drilling and slotting, partial sawing out or butt milling.

The work-table is moved back and forth at uniform speed by a cam and adjustable lever, which can be conveniently and quickly set for any length of stroke within the capacity of



No. 1 Automatic Duplex Slot Milling Machine built by Garvin Machine Co.

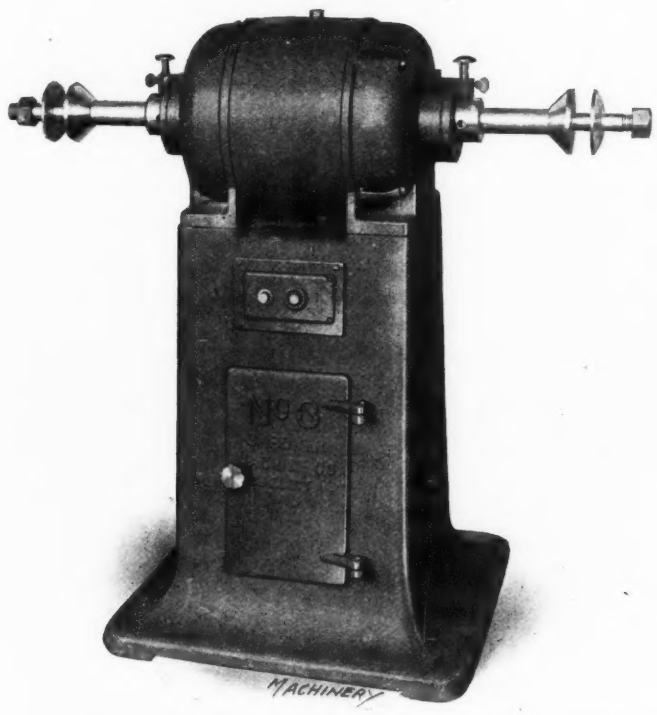
the machine. A cone pulley drive and change-gears provide changes of speed suitable for different conditions, short cuts being taken quickly and longer cuts more slowly. The cam has a large size groove and hardened roller, being driven by a worm-gear; and both the cam and driving gears are adequately protected. The spindle heads are designed for operation at high speed and the spindles are tapered at both ends and run in solid bronze boxes that have adjustment for wear, and means of supporting the thrust. Tapered gibs are provided for the headstock and work-slide, the heads being fed in to cut automatically and simultaneously by right- and left-hand screws controlled by a ratchet. In milling a "through" slot, provision is made for backing away one head automatically when the slot has been almost cut through, so that the other head can continue to advance and complete the slot. In this way no partition is left in the bottom and the work does not require subsequent attention from the operator. The feed by pawl and ratchet is adjustable, and can be set to lift out and

stop feeding automatically when the required depth of cut is made, thus insuring absolute uniformity of product without attention from the operator. Feeding takes place at each end of the stroke.

Each head is independently adjustable along the bed to suit different lengths and conditions of cutters, positions of work on the table, etc. The headstocks are moved in and out simultaneously by a handwheel and may be brought to any position without interfering with the setting of the machine. Work can be set at any angle on the table to produce a taper end in a slot. Two-prong "fish-tail" cutters are used, and adjustable fixtures may be furnished to hold round work. Changes of speed for different sizes of cutters are provided by friction cone pulleys on the countershaft. The spindle pulleys are driven by drums on the countershaft and all working parts are outside the bed where they are readily accessible. All gearing is protected and the machine is equipped with a steel oil-pan and tank, strainer, pump and piping for handling the lubricant. This machine is a recent product of the Garvin Machine Co., Spring and Varick Sts., New York City.

GARDNER POLISHING LATHE WITH PUSH-BUTTON CONTROL

The accompanying illustration shows a No. 3 motor-driven polishing and buffing lathe built by the Gardner Machine Co., Beloit, Wis., which is equipped with push-button control for



No. 3 Gardner Polishing and Buffing Lathe with Push-button Control

starting and stopping the motor. The push-button control station is a very effective and convenient feature; the button on the right is used for starting, and is located below the surface of the plate in order to remove the possibility of accidental starting; the left-hand or stopping button is provided with a simple locking device which constitutes a further precaution against accidentally closing the circuit. Either adjustable or constant speed direct-current motors can be furnished. When adjustable speed is used, the lever within the base is moved to the desired point, and by pressing the starter button the motor comes up to the speed at which it is set. In alternating-current motor-driven machines only certain speeds are available.

The motor is fully enclosed, making it absolutely dust- and dirt-proof. For ventilation a fan attached to the motor shaft within the cover draws air up from the base at the right-hand side and forces it through the motor and down into the pedestal at the left. Perfect air circulation is obtained under all normal conditions. Ample power is provided as demonstrated by the fact that under tests the motors have withstood 50 per cent intermittent overloads of considerable duration. The spindle is provided with a locking device. A button-head pin acting over a coil spring is pushed down into one of the four holes in the spindle collar, which locks the spindle when it is desired to change wheels. In addition to the No. 3 size shown in the accompanying illustration, these machines are manufactured in several other sizes.

Cleveland No. 1 Sensitive Drilling Machine

CLEVELAND SENSITIVE DRILLING MACHINE

The Cleveland Lathe & Machinery Co., Section E, Whitney Power Bldg., Cleveland, Ohio, is now building the No. 1 10-inch sensitive drilling machine here illustrated and described. This machine is built in two types, one of which has the spindle mounted in ball bearings, making it suitable for operation at 5000 revolutions per minute, while the other has a plain spindle bearing and may be run at 1000 revolutions per minute. The design is extremely simple and clearly shown by the illustration. The following are the principal dimensions of the machine: The maximum distance from spindle to table is 7½ inches; maximum vertical movement of spindle, 2½ inches; maximum vertical movement of table, 7½ inches; diameter of table, 8¼ inches; distance from center of spindle to frame, 5⅛ inches; drilling range, all drills up to 5/16 inch in diameter; size of tight and loose pulleys, 4 inches in diameter by 1½ inch face width; and weight of machine, 50 pounds.

AMERICAN CORK-INSET PULLEY

The American Pulley Co., 4208-60 Wissahickon Ave., Philadelphia, Pa., is now manufacturing a line of cork-inset pulleys, one of which is shown in the accompanying illustration. For many classes of service, but especially on main drives, the use of pulleys of this type is the means of materially improving the efficiency of power transmission systems. In many cases belt slippage is not an evidence of faulty pulleys, but is an indication of a too heavily loaded or greasy belt. Where it is found that the load is too great for the drive, the usual practice is to add another pulley to the shaft or substitute a larger one. It is claimed that the same results may be obtained by substituting a steel pulley with cork insets, as the cork improves the grip of the belt on the pulley. The corks are firmly set in the steel, wear indefinitely and are

American Split Steel Pulley with Cork Insets

practically unaffected by dust, oil or water.

Loss of efficiency through belt slippage not only reduces the rate of production and wastes power, but in certain cases failure of machines to operate at the desired speed may be the cause of turning out defective work. In many factories an effort is made to overcome troubles of this kind by lagging and relagging pulleys or by running belts at an excessively high tension, which results in injury of the belt and an abnormally high journal friction. Various belt dressings are also used, and in some cases this practice is followed on a scale that means an appreciable yearly charge on the expense account.

The following results of tests conducted at the Lowell Textile School and at the Worcester Polytechnic Institute show the increase of efficiency which was effected by applying cork insets to different types of pulleys: Gain in steel pulley with cork insets over same pulley without insets, 60 per cent; gain in iron pulley with cork insets over same pulley without insets, 51 per cent; gain in wooden rim pulley with cork insets over plain steel without insets, 42 per cent.

The American Pulley Co. has developed a method of applying cork insets to belt pulleys which does not add to the weight of the pulley. For heavy drives with cork-inset pulleys and little or no belt slip, the first point to be considered is the required width of belt to transmit the load without overstraining the belt. As in the case of other types of pulleys, the face width should be suitable for the belt.

MILBURN WELDING AND CUTTING TORCHES

The illustrations presented in connection with the following description show welding and cutting torches, and the acetylene generator for use in connection with them, which are recent products of the Alexander Milburn Co., 1420-1426 W. Baltimore St., Baltimore, Md. The welding torch shown in Fig. 1 is designed to take advantage of a special method of mixing which produces a uniform welding flame and eliminates back-firing at the tip. Mixing of the gases begins just ahead of the grip, where both the acetylene and oxygen enter a conical shaped chamber under pressure; and the process of mixing continues throughout the passage to the head, being finally perfected within the tip itself. The mixture becomes absolutely uniform through this thorough intermixing, resulting in great steadiness and fine quality of flame. It is also claimed that the torch is economical in its use of oxygen and acetylene. The torch is substantially built of tubing, all parts having ample weight to give the required strength without any unnecessary metal to make the torch cumbersome to use. The arrangement of the grip and valves insures easy handling, and the whole torch is extremely simple and has few parts. Six interchangeable copper welding tips are provided to handle all classes of work encountered in ordinary practice; and union hose couplings facilitate connection and changes of torches. The length of the welding torch is 18 inches and its weight 2½ pounds.

Fig. 1. Oxy-acetylene Welding Torch made by Alexander Milburn Co.

The cutting torch has ample power for working on any thickness of steel within the range of oxy-acetylene cutting; and at the same time it is highly efficient when operating on very light metal. The mixing principle for the heating flame is the same as that employed in the welding torch, resulting in great economy in the use of gas and eliminating trouble from back-firing. The heating gases are mixed throughout their passage from the handle to the head and mixing is finally completed within the tip, the mixed gas being delivered to the flame at uniform positive pressure. The high-pressure cutting oxygen is controlled by a positive thumb valve which opens and closes quickly with a spiral motion; this valve will remain fixed in either the open or closed position without pressure from the hand. The cutting oxygen is led to the center of the flame by means of the upper tube and a central orifice in the tip, producing a thin, sharp kerf. The head and tip of the torch are of very simple construction, with no small parts to get out of adjustment or burn out. No parts are concealed in the handle and all valves are accessible from the outside. Three interchangeable tips are provided for light, medium and heavy cutting operations. Union hose couplings are used which are interchangeable with the welding torch. The length of this torch is 18 inches and its weight 3½ pounds.

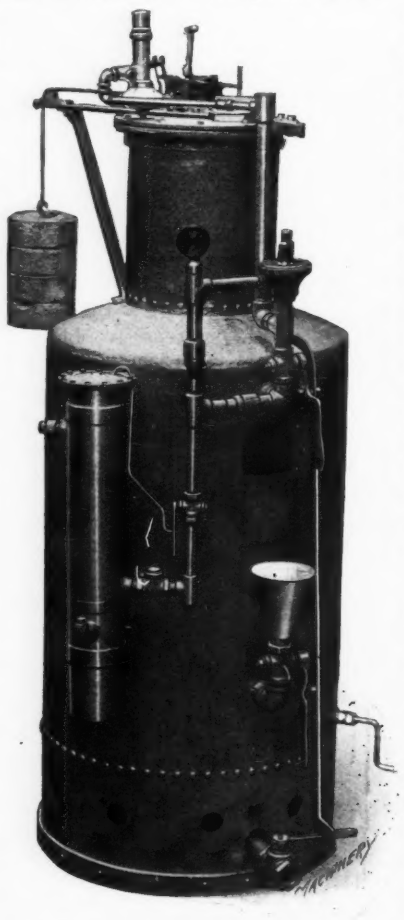


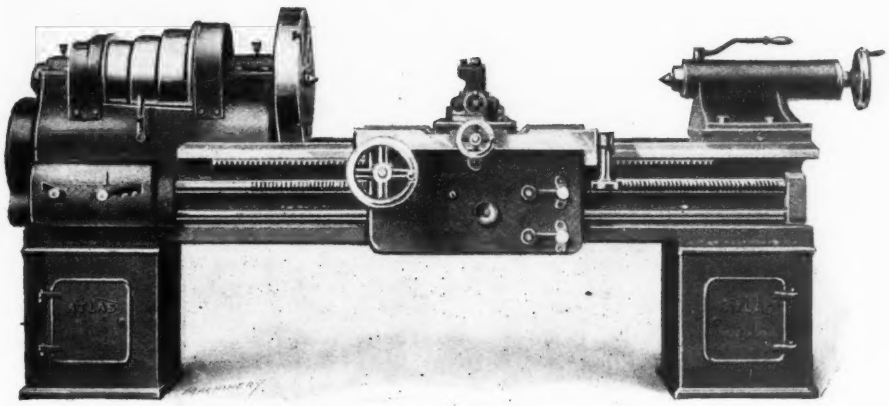
Fig. 2. Acetylene Generator built for Use with Milburn Welding and Cutting Torches

The Milburn acetylene generator shown in Fig. 2 is substantially constructed and provided with positive automatic feed mechanism and all devices for safety and convenience. It is included in the list of standard devices published by the National Board of Fire Underwriters and has also been approved by the New York Fire Department. The generator is built of heavy gage steel with oxy-acetylene welded joints, and is galvanized complete after the welding has been finished. All fittings are made of malleable iron, steel or brass. For use in connection with welding and cutting outfits, the company is prepared to furnish oxygen and acetylene pressure regulators which insure steady regulation of gas and eliminate valve and gage troubles. These regulators are very accurate and give any desired pressure from the full tank pressure down to a few ounces per square inch.

Fig. 3. Milburn Oxy-acetylene Cutting Torch

CLEVELAND ENGINE LATHE

The 18-inch double back-geared engine lathe illustrated and described herewith is a recent product of the Cleveland Lathe & Machinery Co., Section E, Whitney Power Bldg., Cleveland, Ohio. The hollow spindle is made of 50-point carbon steel; and the feed-shaft and lead-screw drives are both reversing in the head. In ad-



Double Back-geared 18-inch Engine Lathe built by Cleveland Lathe & Machinery Co.

dition, separate reverse for the feeds is provided in the apron. Eighteen changes of speed are available; and a positive quick-change drive is provided for the feed-shaft. The carriage has a bearing for its entire length on the vees; and the apron is of the double plate type which affords a double bearing for all shafts and studs, thus preventing overhang and consequent strain. The regular equipment included with the lathe consists of a steadyrest, large and small faceplates, change-gears, a double friction countershaft, indicating dial for thread cutting, and the necessary wrenches for making all adjustments.

The principal dimensions of this lathe are as follows: swing over bed, 18½ inches; swing over carriage, 12¼ inches; distance between centers for an eight-foot bed, 45 inches; diameter of front journal, 3½ inches; length of front journal, 6½ inches; diameter of rear journal, 2¾ inches; length of rear journal, 6 inches; length of carriage on shears, 30 inches; diameter of hole through spindle, 1 9/16 inch; diameter of tailstock spindle, 3 inches; travel of tailstock spindle, up to 7½ inches; taper of spindle centers, No. 5 Morse; diameter of cone pulley steps, 9, 10½ and 12 inches; width of driving belt, 4 inches; ratio of back-gears, 3.7 to 1 and 10 to 1; pitch of lead-screw, 4; range for thread cutting, 2 to 24 threads per inch; and net weight, with eight-foot bed, 3400 pounds.

JENCKES BAND TURNING LATHE

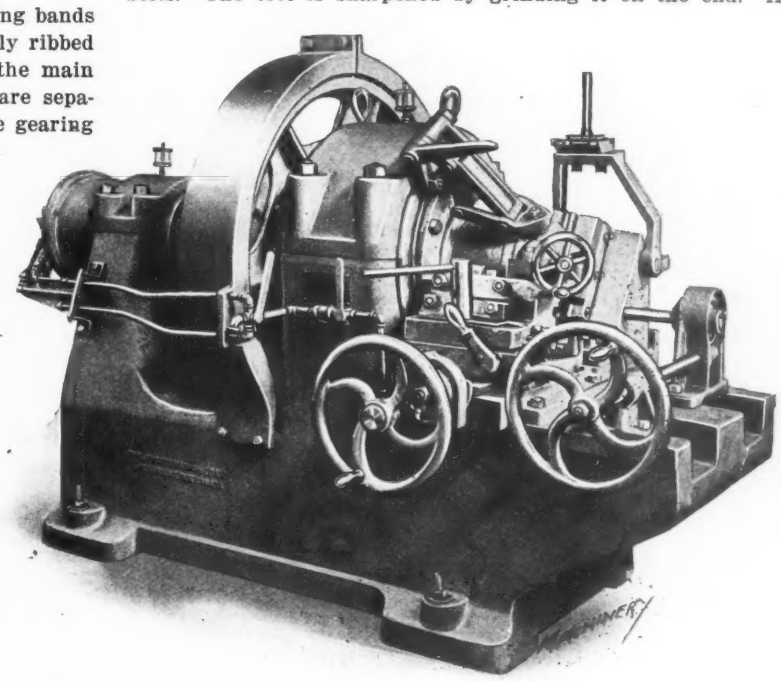
The Jenckes Machine Co., Ltd., Sherbrooke, Quebec, Canada, has recently placed on the market the single-purpose lathe illustrated and described herewith, for turning copper bands on British shells. This machine is especially adapted for operation on 8- and 9.2-inch British shells, and is equipped with an air chuck to facilitate rapid handling of the work. The spindle is enlarged to provide for turning and finishing bands on shells up to the 12-inch size. The bed is a heavily ribbed box section that extends to the rear and supports the main driving shaft and pinion. Bearings for this shaft are separate and bolted to planed pads in order to match the gearing properly. The main spindle bearings are cast integral with the bed, the front bearing being 16 inches in diameter by 14 inches long, and the rear bearing 9 inches in diameter by 10 inches long. The bearing caps are machine fitted and held to the bed by four heavy studs in each cap. The bearings are lined with babbitt metal which is hammered into place, bored and scraped to fit the spindle accurately. Means of compensation for wear are provided by placing a number of shims between the cap and bed before the boring operation; and when the final adjustment is made, the cap is drawn solidly down onto the shims.

The spindle is a heavy steel casting finished by turning on the outside, boring on the inside and finally grinding to the required size. The shell is held in this spindle by a Jenckes collet type of chuck, controlled by an air cylinder at the rear of the spindle, and the jaws are positively closed or opened by means of a four-way valve. The drive is transmitted through a heavy back-shaft and cut gearing having a reduction of 4½ to 1. An air clutch pulley is provided on this shaft, which is of the taper type with cork insets, the clutch being controlled by means of an air cylinder and three-way valve located near the operator's stand. Springs under compression release the clutch when the air is turned off.

The rough-shaping of the band is accomplished by means of two form tools made of high-speed steel, which are comparatively long-lived, as they are ground on the ends in sharpening, which does not change their shape. Each of the tools is securely held in a dovetailed fit in a steel tool-block by two ¾-inch taper-head bolts. Both tools are further supported by an adjustable jack, so that the clamping effect of either tool helps to hold the other, and permits of quickly replacing the tools after they have been ground. Each tool cuts approximately one-half the band width, and the tool-block has a quick and convenient shift in a sidewise direction by means of a rack and pinion; it is accurately located by a single stop-rod and lock-nut.

An accurate method of determining the depth of cut is provided by means of a graduated dial and two adjustable pins that can be screwed in or out, and which come flush with the face of the feed-screw housing when the tool has approached the desired depth of cut. The exact depth is determined, however, by means of a pointer and adjustable dial, making it possible for the operator to hold the cut within close limits. The under-cutting operation is effected by means of a separate tool and block mounted on the main or roughing tool-block. This is in line with the under-cut when the tool nearest the base of the shell has finished its work and been slightly withdrawn.

The band is finally finished by means of a shaving tool which is arranged to feed down an inclined block at the rear of the shell. This block is furnished with a slight adjustment to or from the shell, and means are also provided to rotate the block slightly in order to vary the diameter of the band at each end. The feed of the tool is through a rack and pinion on the block, and then through a worm and wheel to the hand-wheel at the front of the machine on the operator's right hand. The tool used for this work is made of high-speed steel with the face milled to the exact contour of the finished band. It is located in the slide by a dovetail that supports the full length of the tool, and is held securely by a clamp and two bolts. The tool is sharpened by grinding it on the end. A



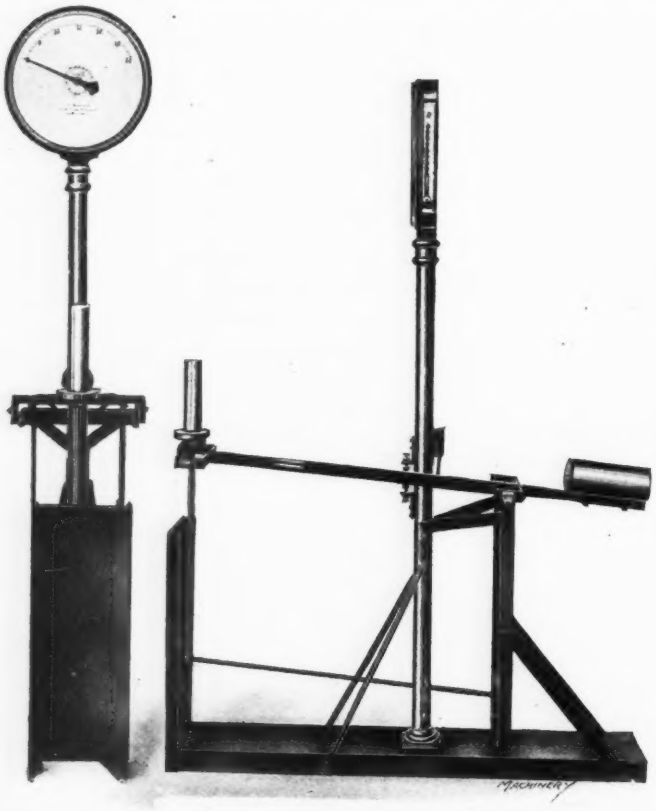
Special Lathe built by Jenckes Machine Co. for turning Copper Bands on British 8- and 9.2-inch Shells

double scraper tool is attached to this back tool-block and is made adjustable sidewise to bring it into alignment with the finishing tool. The two scraper tools are set in slots in the tool-block at the correct distance apart for the width of the band; each tool is adjustable by means of set-screws so that they can be made to come down close to the shell without actually cutting the steel.

The tool-block is counterbalanced and swung up out of the way while the shell is being set up or removed from the machine. The work is located in the chuck by means of a swinging stop attached to the cap above the spindle; this stop swings down and is located in position by means of a toggle lever, the shell being pulled back until the band bears against a stop, after which the operator turns on the air to close the chuck, swings the stop up out of the way, turns the air on the clutch pulley which starts the machine, and proceeds to feed in the roughing tool which performs the first operation.

CHATILLON AUTOMATIC TEST SCALE FOR SHELLS

John Chatillon & Sons, 85-93 Cliff St., New York City, have recently developed a scale for indicating whether a shell is under or over the prescribed weight, which in the case of the shell shown in the accompanying illustration is 5 pounds, 11 ounces and 5 drams. It will be observed that the weight of the shell is entirely counterbalanced, thereby confining the fluctuations of the pointer to an indication of variation. In order to show this clearly, a reading index 13 inches in length is provided, which covers a range from 8 to 14 ounces by drams. For the shell referred to, a test weight of 5 pounds, 8 ounces is furnished, so that the operator can see at any time if the scale is in balance. While this scale was developed primarily for handling 3-inch shells, it can be adapted for handling larger sizes.



Chatillon Test Scale for determining Variation of Shells from Standard Weight

NORRMAN AUTOMATIC MULTIPLE ADJUSTING PEN

Many have undoubtedly noted the inefficient and unscientific methods employed at present in tracing or inking in drawings —especially machinery drawings—where many fine, heavy and dotted lines are intermingled. It is, of course, impossible to work out any standard methods, since the conditions vary with each individual case, and the draftsman has generally been allowed to follow his own judgment in doing this work. Sometimes he frequently adjusts and readjusts the pen in drawing these lines, without any system at all. This, of course, results in slow and inefficient work; and the experienced draftsman, in order to do his work quickly and neatly, traces in the heavy lines first and then inserts the fine and dotted lines later, or *vice versa*. By this method, however, the draftsman will have to locate the lines twice and adjust the T-square or triangle twice before a line can be completed. The expenditure in physical and mental energy is consequently about twice as great as it actually should be; and before a drawing is completed this has been repeated several hundred times. Furthermore, in inking in fine lines exclusively, it frequently occurs that the ink will not run freely. It dries in the pen, forming a crust that can be removed only by cleaning. As a result, inking in is a slow and tedious process.

It was in an endeavor to improve these conditions that A. E. Norrman, P. O. Box 701, Portland, Me., gave this matter thorough consideration and found that the modern principles of efficiency could be applied to advantage in the process of tracing or inking in, thereby improving the present wasteful methods. For that purpose it was, however, necessary to design a drawing pen with entirely new facilities, making the pen automatically adjustable for lines of different thicknesses in such a way that the adjustment could be altered at will. This problem was successfully solved, and the specific improvements are embodied in a detachable adjusting device that can be applied to any standard drawing pen without necessitating alterations of any kind in the pen itself. This device is shown in the accompanying illustration in different modifications, in combination with a standard pen, a compass and a pen with a special attachment for spreading the blades for cleaning. It will be seen that the detachable adjusting device for the standard pen consists principally of a specially shaped lever and cam-lever that is pivoted to the lever formed so as to fit the upper blade of the pen and clamped to it by means of the ordinary adjusting screw. The cam-lever is provided with two operating points, both co-acting with adjusting screws located on each side of the pivot, so that in the operative position of this cam-lever both points will bear evenly on the blade, while a projecting part of the lever forming an operating handle extends over the head of the adjusting screw of the pen. The operating point toward the nib of the pen is shaped as a cam and co-acts with an adjusting screw in the rear part of the cam-lever, while the operating point in the front is shaped distinctly as a lever and co-acts with a screw in the operating handle immediately above the ordinary adjusting screw.

When the cam-lever is in its inoperative position, the pen can be adjusted to draw a heavy line by means of the ordinary adjusting screw, the cam-lever being kept firmly in place by the spring action of the blades of the pen. It will now be noticed that in holding the pen in the correct position for drafting, the index finger of the user rests directly on the wide-headed adjusting screw in the operating handle of the device, and enough pressure may be exerted on the head of this screw to hold the pen firmly. The pen, of course, will now draw a heavy line. If sufficient pressure is exerted on the head of the large adjusting screw to overcome the spring action of the blade of the pen, the adjusting lever will act on the blades, forcing them to close until the co-acting adjusting screw rests on the head of the adjusting screw of the pen. The pen will now draw a fine line that can be adjusted by means of the large adjusting screw of the device. As soon as the pressure is removed, the spring action of the blades will force the pen back into its former adjustment, thus drawing a heavy line. The pressure required for this adjustment is slight, yet very distinct, and thus we have the means to change quickly and accurately the adjustment of the pen during drafting.

The operating lever can also be swung back into a position where the small adjusting screw in the rear will rest on the upper blade of the pen. In this position the adjusting cam will act on the pen, and the pen will draw a fine line that can be adjusted by the small adjusting screw. This adjustment will be self-locked by the spring action of the blades, and the

Norrman Detachable Adjusting Device for Standard Drafting Pen; Adjusting Device with Means for spreading Blades; and Compass fitted with Adjusting Device

pen will draw a fine line as long as the operating lever remains in this position. It is desirable that adjustment of the pen from a heavy to a fine line and *vice versa* should be accomplished in a minimum of time, in order to draw lines that appear partly heavy and partly fine. This is accomplished with the adjusting lever that requires a motion of only a few hundredths inch for the adjustment. On the other hand, in drawing fine lines exclusively or fine lines with an intricate curvature, it is not always possible or convenient to exert the required pressure on the head of the large adjusting screw, and in that case the self-locking cam adjustment should be used. Therefore, if the three line adjustments are all made different, the self-locking adjustment should be made fine to draw center lines, dimension lines and lines for cross-hatching, while the self-releasing adjustment should be used for dotted lines only, and made just a shade finer than the heavy line adjustment. In this way, very attractive and clear drawings are secured.

It must be mentioned that the operating handle is in immediate proximity to the index finger of the user so that efficient handling of the pen will be easily acquired. Great care has also been exercised to make the details of the device fulfill all requirements. The multiple adjusting pen is neat, simple and of a practical construction. The pen with the attachment for spreading the blades is practically the same as the standard multiple adjusting pen, except for a special filler piece between the base of the adjusting device and the upper blade of the pen. A sliding motion of the filler piece will effect the closing and the opening of the blades. For the compass, only the self-locking adjustment has been provided, and the device has been clamped to the compass pen in a somewhat different manner, as it can be operated to better advantage in this position.

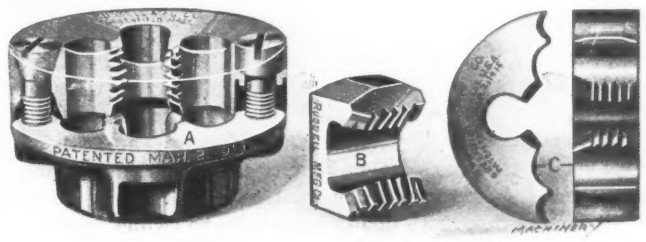
It seems obvious that up to the present time very little attention has been given to the process of inking in or tracing drawings. So, for instance, it is possible to see draftsmen who handle the pen in an entirely incorrect and unwieldy manner, and it seems that many students in receiving instructions simply have been requested to produce a certain drawing to conform with a given sample, but they have been able to suit themselves as to how to produce it. Also the time and personal effort required to make a certain drawing has never been seriously investigated. However, in using the new multiple adjusting pen in a systematic manner it is evident that great saving in time and energy can be achieved, besides making the occupation of drafting easier and more pleasant for the draftsman. Instead of searching all over the drawing for lines of the particular thickness for which his pen is set, he can confine his attention to one part of the drawing, inking in fine lines, dotted lines and heavy lines as he proceeds from one part of the drawing to the other. He will finish his work in less time and make a better looking drawing, as all the various lines are of a uniform thickness. He will also save much mental effort and worry, as the annoying search for small odds and ends will practically be eliminated. It will also be noted that in constantly changing the automatic adjustments of the pen the crust that forms in the drying of the ink will be broken up, and actual experience in using this pen has proved that the ink will run freely and the lines will be of uniform thickness, whether the pen is full of ink or nearly empty.

There is, furthermore, another side of the question that has not been given due attention. This is the time it requires to read a drawing. In many factories it is customary to send out from the drafting department almost unreadable blueprints from pencil sketches. Frequently it is requested that the dotted lines be of the same thickness as the full lines, screw threads are not always shown with the customary alternate fine and heavy lines, and the use of light and shade lines has already long been abolished—all in an effort to cut down the cost of drafting to the absolute minimum. However, there can be no question of the advantage of a clear and easily read drawing. It eliminates the possibility of costly mistakes. The man in the shop, the patternmaker, machinist or assembler—whoever it may be—will spend less time in studying the drawing and more for actual productive work, and as he is often a higher paid man than the draftsman, the saving will be worth considering. Many times the chief engineer or the superintendent has to spend much of his valuable time in studying a drawing that could have been made much clearer by a little more care and attention on the part of the draftsman. Therefore, if we sum up all the advantages derived from the use of the new multiple adjusting pen, we find that it not only facilitates the work of the draftsman and enables him to give better service to his employer, but it will also indirectly result in greater efficiency in the shop.

RUSSELL DOUBLE REVERSIBLE DIES

The dies in all screw plates made by the Russell Mfg. Co., Greenfield, Mass., are now made to cut from both faces and are known as "double" dies. This development enables them to do certain classes of work which cannot be performed with other styles of dies. For instance, when a thread is to be cut close up to a shoulder or a very short piece is to be threaded, the cut should be made from the front face of the die. In this way, the space which the thickness of the guide prevents being utilized when cutting from the guide side of the die can be threaded, enabling the die to cut right up to the shoulder or work-holder. This double die feature makes it possible to use the same die for either hand or machine work, as well as to accomplish the kinds of work described without turning the die over. The dies are also reversible, making it possible to turn the die over in its holder when a set of cutting edges has become worn out, thus bringing the other set of cutting edges into action and doubling the life of the die. Double dies have been made before and also reversible dies, but we believe that this is the first case in which the double and reversible features have been combined in a single die.

In the accompanying illustration, the view shown at *A* illustrates the Russell style A die, where it will be seen that the double reversible feature is provided by countersinking and counterboring the screw holes in both faces, so that the die may be turned over on the guide. The Russell style B die is shown at *B*, and this view illustrates how the same result is obtained by having a double bevel on the outside of the die so that it may be turned over in the collet. One of the Russell full mounted dies is shown at *C*, where it will be seen that the same result is obtained for this type of die by having the screw holes countersunk from both faces, so that the die may also



Russell Styles A, B and C Double Reversible Threading Dies

be turned over on the stock. This is a development in threading dies which should be greatly appreciated by all mechanics who are called upon to use tools of this kind.

SIPP SPECIAL DRILLING MACHINES

The machines described in the following article were developed to meet special requirements met with in machining crankshafts provided with a forced-feed lubricant system. They combine the features of this company's regular drilling machines with special means for the performance of those drilling operations referred to in connection with the machines. The automatic power feed mechanism represents an improvement recently developed for use on the standard Sipp drilling machines.

For the purpose of drilling all angular oil-holes for the forced-feed lubrication system in crankshafts, the Sipp Machine Co., Paterson, N. J., is now building the special drilling machine illustrated in Figs. 1 and 3. In addition to its use for this purpose, the machine may be employed for the performance of light vertical milling operations; and it is also well adapted for the performance of various classes of toolroom work. It will be evident from the illustration that provision is made for tilting the table to any required angle by rotating the table support through a worm and worm-wheel; and a graduated collar on the support facilitates setting the table to an angle corresponding to the required angle for the oil-hole in the crankshaft. In addition, the table is provided with the usual vertical movement by means of a screw, which amounts to 14 3/16 inches irrespective of the traverse movement of the spindle bracket and spindle sleeve. The spindle bracket has a traverse movement of 14¾ inches, and the sleeve has a feed movement of 5½ inches. The table may be tilted to an angle of 80 degrees from the horizontal to either the right or left of the neutral position; and, as previously mentioned, it is equipped with a graduated ring for the entire circle of 360 degrees; when the table has been moved to either the right or left through a distance of 3 or 4 inches, the ball-crank will clear the base, and the table can then be turned through a complete circle, if so desired.

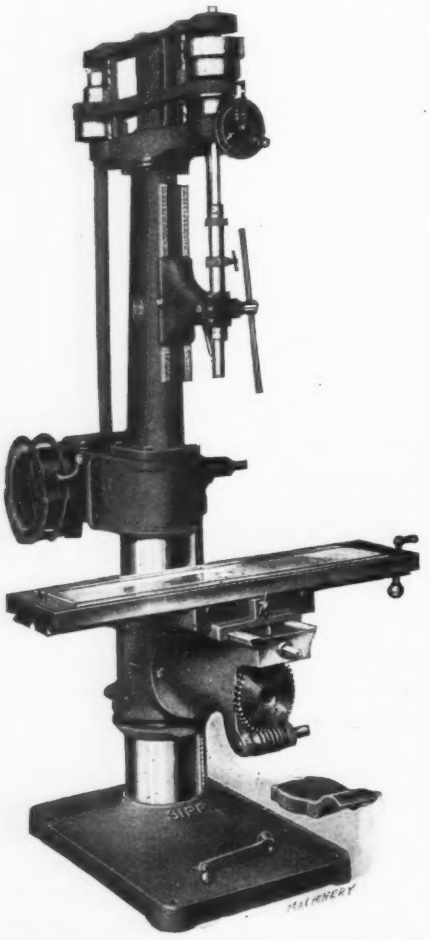


Fig. 1. Sipp Crankshaft Oil-hole Drilling Machine with Table in Horizontal Position

The working surface of the table is 10 by 36 inches, and the minimum distance between the spindle and table is 2 5/16 inches, while the maximum distance from the spindle to the table is 31½ inches. The travel of the table from right to left or *vice versa* is 14 inches on each side of the center, making a total table travel of 28 inches; and the cross-slide has a traverse of 4 inches forward and 3 inches backward from the central position, making a total traverse motion of 7 inches. The entire table support can be swung around the column 65 degrees to the left and 48 degrees to the right of the central position. The table is provided with two longitudinal T-slots, spaced 6 inches apart from center to center. This machine will drill a hole to the center of an 18-inch circle.

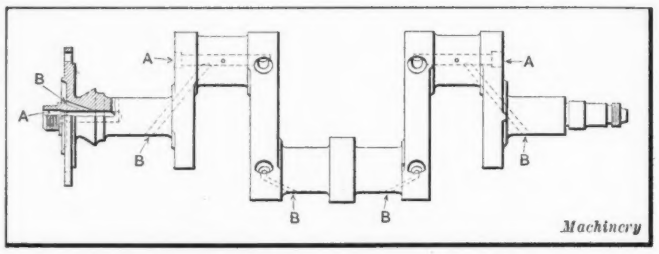


Fig. 2. Crankshaft with Forced Lubrication System, showing Angular Holes drilled on Sipp Machine shown in Figs. 1 and 3

Machine for Drilling End Hole in Crankshaft Forced Feed

The machine shown in Fig. 3 was especially developed for use in drilling the hole in the center of the bearing at the inlet end of the crankshaft forced-feed lubrication system. The jig is clamped at the top of the table and the crankshaft is located in this jig with ample space from the top of the table to the foot of the base for handling crankshafts up to and including 32½ inches in length below the coupling flange. In addition, it will be evident from the illustration that this machine can be used for regular drilling operations. Important dimensions are as follows: maximum distance from end of spindle to top of table, 32½ inches; size of working surface of table, 16 by 40 inches; distance between centers of two longitudinal T-slots, 6 inches. The table is raised and lowered by a crank-actuated rack and pinion, and the use of this machine eliminates any obstruction under the center of the table, allowing the crankshaft or other work to hang in free space.

Crankshaft Centering Machine

Fig 4 illustrates a machine designed for use in centering crankshafts. A dead male center is brought up into position by depressing a foot-treadle, and the cup center locates the crankshaft ready for the centering operation. It has an overhang of 8 inches; the maximum distance from the nose of the spindle to the cup centers is 40 inches, and the minimum distance from the nose of the spindle to the cup centers, 25 inches. The maximum length of hand feed is 5½ inches, and the maxi-

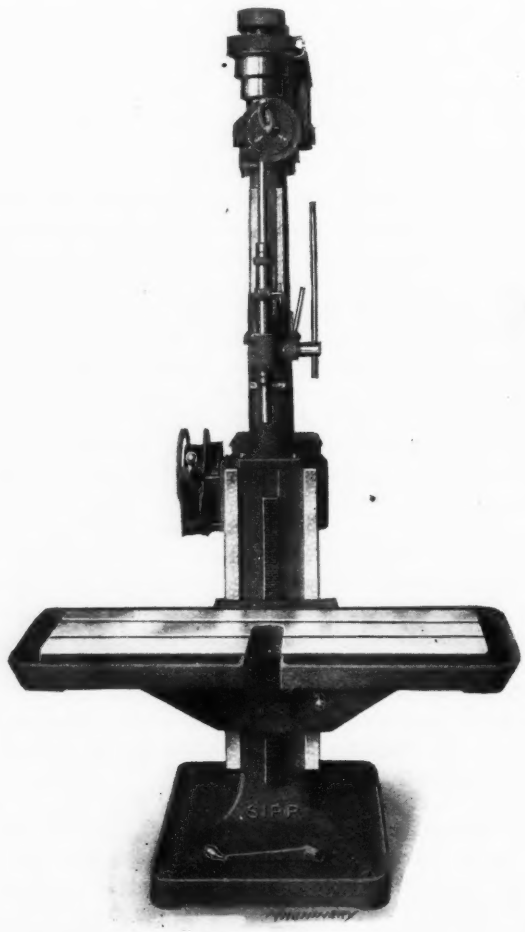


Fig. 3. Sipp Machine for drilling Hole at Inlet End of Crankshaft Forced-feed Lubrication System

mum traverse of the spindle head, 9¼ inches; the total spindle adjustment is 14¾ inches, and other dimensions are the same as those of the single-spindle Sipp drilling machine illustrated and described in the January, 1915, number of MACHINERY.

Automatic Regulation of Belt Tension on Sipp Drilling Machines

All the Sipp drilling machines are equipped with a special form of adjustment for the belt tension which automatically compensates for any differences in the load. For instance, consider the moment when the spindle has been fed down to the point where the drill engages the work; any one who has observed the belt action at this time will have noticed that the tight or driving side of the belt stretches, and that there is a corresponding increase of length on the slack side. Similarly, if the belt is carefully watched at the time the drill breaks through the work, it will be noticed that the driving tension is reduced, and consequently the length of belt on the short side is correspondingly decreased. In either of these cases the adjustable idler pulley shown at *C* in Fig. 5 changes its position so that the belt tension is maintained constant. This result is obtained by means of a torsion spring contained in case *E* which causes the idler pulley to move in or out as the case may be. The strength of the spring may be adjusted so that exactly the required belt tension is obtained, and it is important to note that at those times when an exceptionally heavy load is imposed on the drive, the idler pulley will slack off and reduce the tension of the belt before the strain becomes great enough to stretch the belt beyond its elastic limit, or strain any part of the machine. In this way the life of the machine and belt are materially increased.

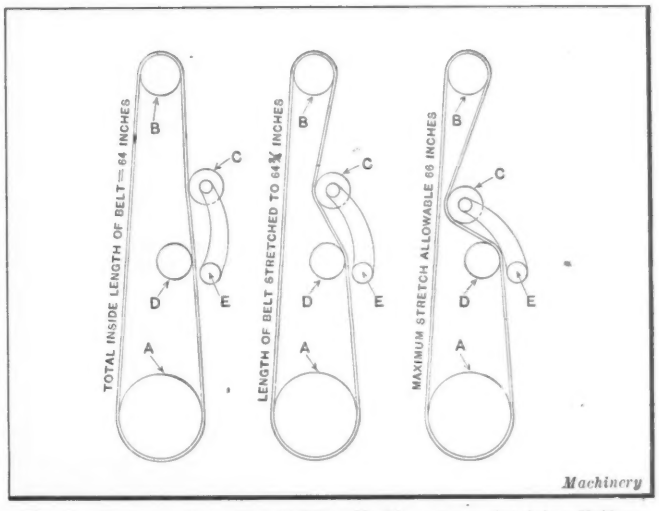


Fig. 5. Device used on Sipp Drilling Machines for maintaining Uniform Belt Tension

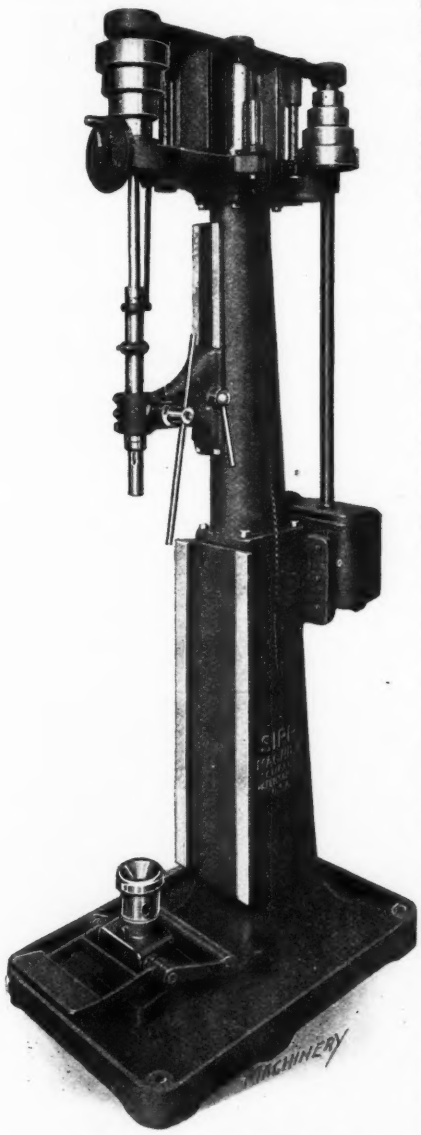


Fig. 4. Crankshaft Centering Machine

Automatic Power Feed for Drilling Machines

With the view of giving machine operators the maximum amount of time for handling finished work and getting new blanks or castings ready for drilling, the Sipp Machine Co. has developed an automatic power feed mechanism for use on its drilling machines. This provides for feeding the spindle down by hand until the point of the drill is brought into contact with the work, at which time the power feed mechanism is automatically engaged; the operator can then leave the machine, as the power feed is disengaged when the required depth of hole has been drilled, and the spindle is then returned automatically by a counterweight inside the column. An air cushion absorbs the shock at the time the spindle reaches the top of its travel.

The mechanism by which these results are obtained is shown in Fig. 6 on the spindle at the right-hand side of the machine. Referring to this illustration, it will be seen that a rod *A* is carried by brackets attached to the spindle quill; this rod moves with the spindle, and at the time when the point of the drill comes into contact with the work, a stop carried by rod *A* engages trip lever *B* which results in automatically throwing in the power feed that is obtained through the familiar form of worm and worm-wheel. The feeding of the drill then continues until the hole has been cut to the required depth, at which time knock-out *C*, which is of the usual form, disengages the power feed and allows the spindle to be automatically returned by means of the counterweight previously referred to. The momentum of the rising spindle is absorbed by an air cushion effect contained in dash-pot *D*, so that no vibration is set up at the time the spindle reaches the other position. It will be evident that this automatic feed mechanism replaces the previous type in which it was necessary to engage the power feed by hand after the drill had been brought down into contact with the work. The three left-hand spindles on the machine shown in Fig. 6 are equipped with the form of mechanism in which the feed is engaged by hand by pulling out the smaller lever shown at *E*. The reason for this design was that the holes drilled by the three left-hand spindles are deep enough to give the operator plenty of time to handle the finished work.

The spindle sleeve is controlled and held in rigid alignment by a steel saw blade running in a spline 3¼ inches in length, which insures positive rigidity and long wear and does not allow of any rotation or loosening of the sleeve. This is par-

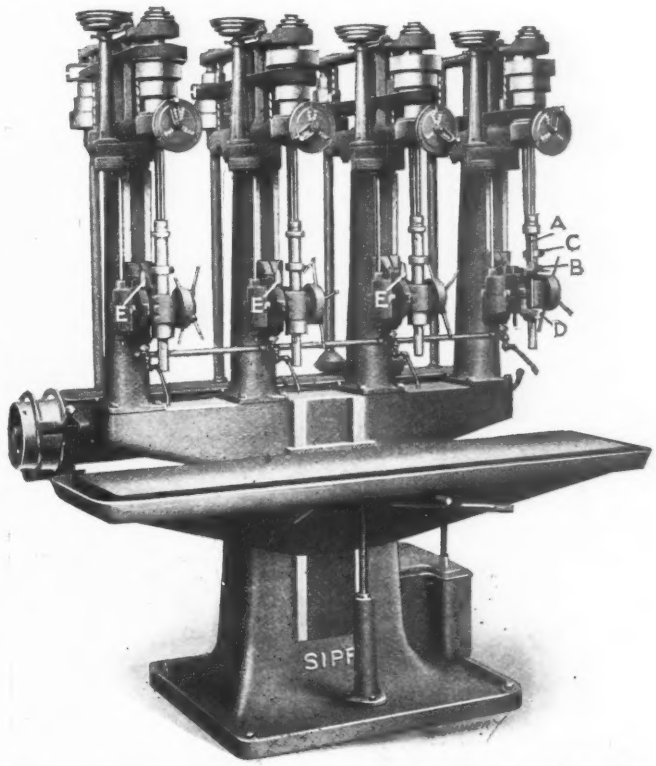


Fig. 6. Sipp Four-spindle Drilling Machine on which Right-hand Spindle has Automatic Power Feed Mechanism

ticularly advantageous in case the machine is to be used at some future time in connection with a multiple drill head, for in such a case it is necessary for the spindle sleeve to be held in a rigid manner to insure the drilling head being held in proper alignment so that the drills will not bind.

LUNDVALL FUSE RING MILLING MACHINES

These machines for rough- and finish-milling the powder train groove in time fuse rings are of similar design, the chief distinction lying in the fact that the roughing cut is taken with a circular milling cutter and the finishing cut with an end-mill. The roughing cutter leaves an arc of metal at each end of the groove, and in order to obtain the highest efficiency in operating the finishing machine, means are provided for using a slow speed while the cutter is taking a heavy cut at the ends of the groove, and automatically increasing the speed during the time that the light cut is being taken in finishing the remainder of the groove.

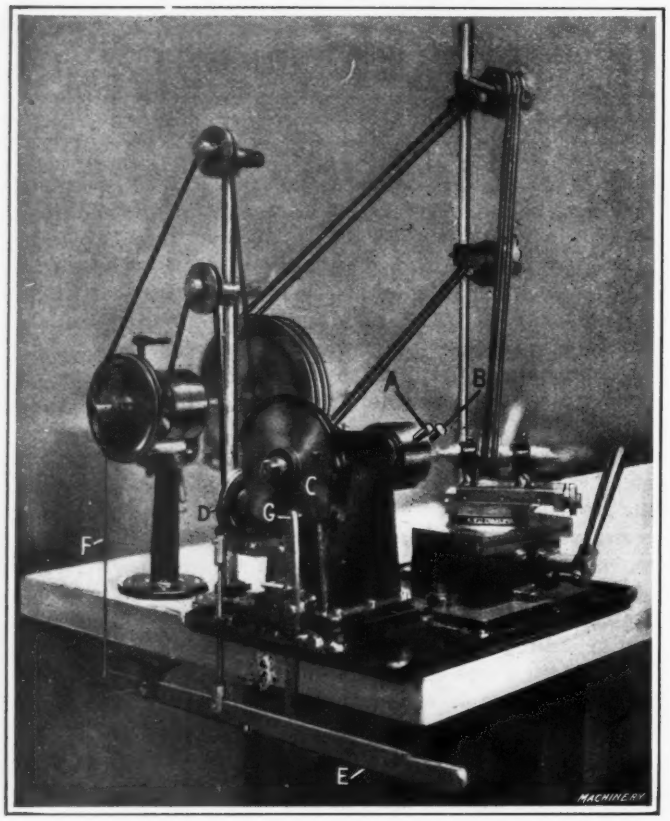


Fig. 1. Lundvall Machine for roughing out Powder Train Groove in Time Fuse Rings

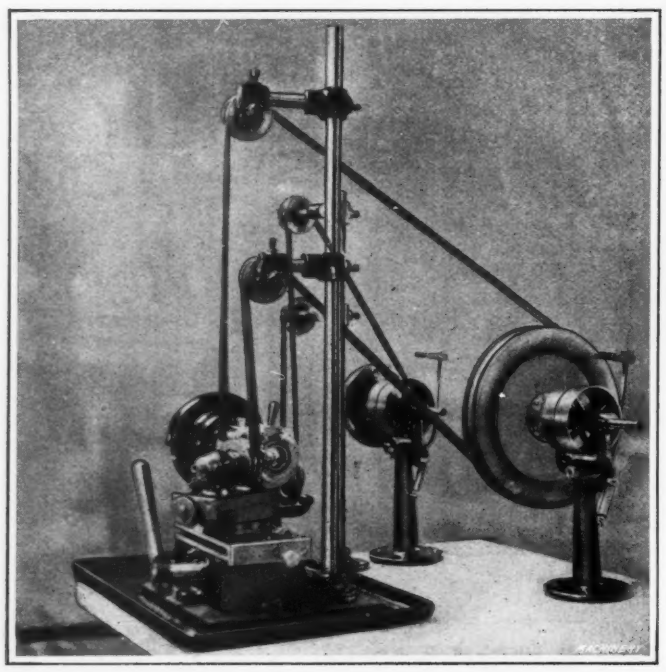


Fig. 2. View of Machine showing Work in Chuck and Roughing Cutter

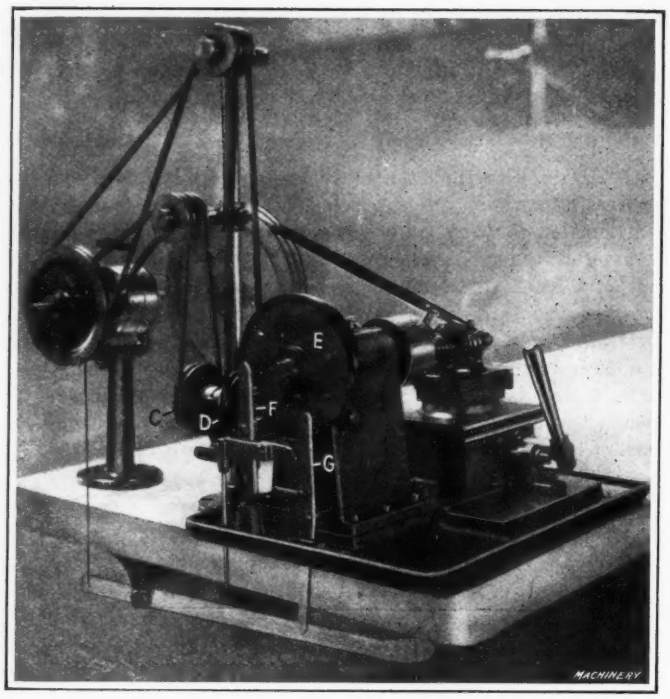


Fig. 3. Lundvall Machine for finish-milling Powder Train Groove in Time Fuse Rings

For use in rough- and finish-milling the powder train groove in fuse rings, E. A. Lundvall, 24 Belmont Ave., Jersey City, N. J., is now building the milling machines illustrated and described herewith. It is general practice to rough out the groove with an end-mill, but experience has shown that the use of a circular milling cutter of the type used on the roughing machine enables the work to be done much more rapidly. When the first machine has done its work, the fuse ring is transferred to the finishing machine which uses an end-mill to finish the groove to exactly the required size.

The Roughing Machine

The machine employed for roughing out the powder train groove is illustrated in Figs. 1 and 2. It will be seen that

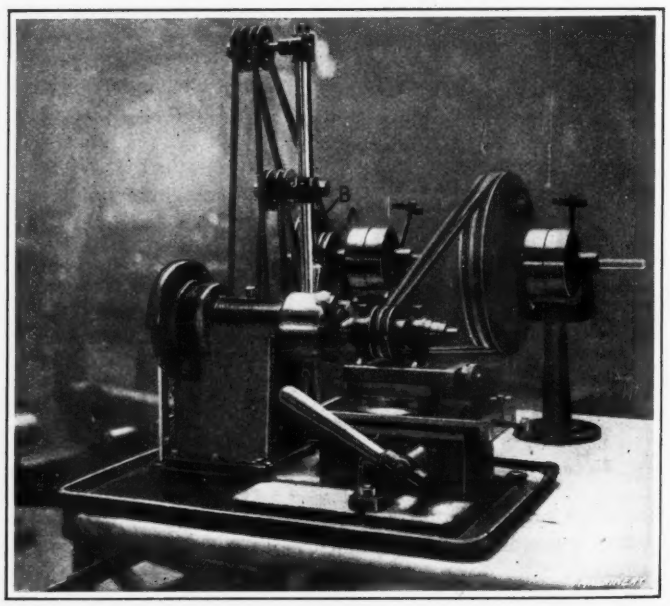
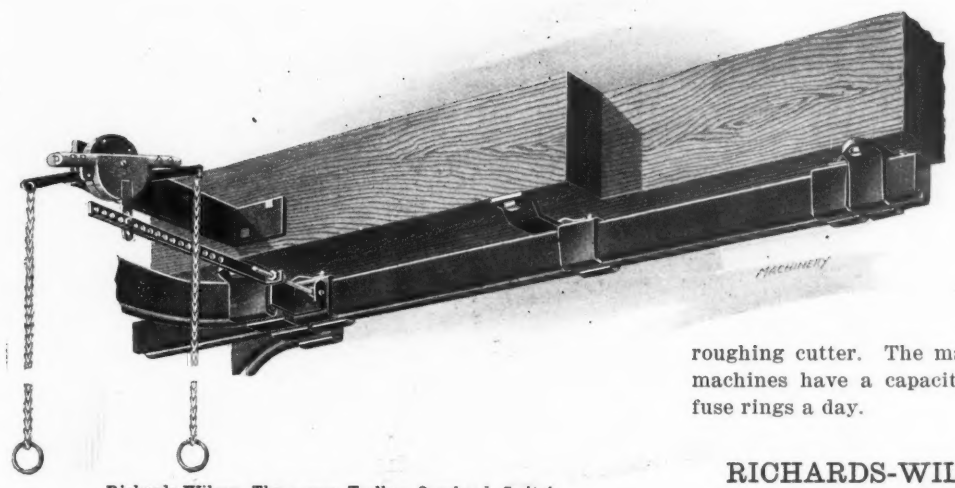


Fig. 4. Lundvall Machine showing Work in Chuck and Finishing Cutter

the work is held in a two-jawed chuck which is opened and closed by turning lever *A* that actuates the jaws through a cam ring. The work is located in the chuck by means of sliding pin *B*. After the fuse ring has been set up in the chuck, the desired location for the powder train groove is obtained by means of index plate *C*, which has two notches that govern the length of the groove and its location. Reference to these illustrations will make it apparent that the cutterhead is driven by two round leather belts, the double belt being provided in order to give the required driving force



Richards-Wilcox Three-way Trolley Overhead Switch

without employing an unduly high belt tension. The work is fed to the rotating cutter by means of pulley *D* which is also driven by a round leather belt.

After the work has been set up and the cutter-head moved over to feed the cutter into the work to the required depth, the cutter-head is locked against longitudinal movement by means of a suitable latch. The operator then pulls up on lever *E* which results in withdrawing the locking pin from index plate *C* and at the same time throwing the driving belt onto the tight pulley of the countershaft, thus starting the machine. It will be apparent that the locking pin is withdrawn through the action of a system of links connected with lever *E*, and the simultaneous shifting of the driving belt to the tight pulley is effected by a wire *F* which connects the end of lever *E* with the belt shifter. When the work-spindle has rotated through a sufficient distance to complete rough-milling the groove, the plunger comes opposite the second notch on index plate *C*, and at the same time a stop on this plate engages the upper end of lever *G*, allowing the plunger to drop into the notch in the index plate and lever *E* to shift the belt back onto the loose pulley.

The Finishing Machine

After comparing Figs. 1 and 2 with Figs. 3 and 4, the reader will have observed that the machines for rough- and finish-milling the powder train groove are similar in many respects, The chief points of difference are that an end-milling cutter is used for the finish-milling operation; and in order to obtain the highest possible efficiency, the work must be run at a slower speed during the beginning and end of the operation, while the cutter is removing the arc left by the circular milling cutter which performs the roughing operation; then while the intermediate part of the cut is being taken, it can run at high speed, as the cutter is only removing a very small amount of metal at this time. The change of speed is effected automatically by means of a two-speed drive from pulleys *A* and *B* (Fig. 4) on the countershaft, from which belts run over the idlers to pulleys *C* and *D* between which is located a positive clutch. The ratio of pulleys *A* and *B* is 1 to 2.

The work is set up in the machine and the machine started by operating the hand lever, as in the case of the machine for rough-milling the groove. Then during the first part of the operation the work is rotated at slow speed, while the end-mill is removing the arc left by the circular rough-milling cutter. When this part of the operation has been completed, a pin carried by index plate *E* engages the top of lever *F* which actuates the load and fire clutch between pulleys *C* and *D*. This results in throwing the clutch out of engagement with the slow-speed pulley and connecting it with the high-speed pulley, so that the speed of rotation may be doubled while the central part of the groove is being finish-milled. Then when the cutter comes into contact with the arc of metal left at the opposite end of the groove, a second stop on index plate *E* engages lever *F* and results in throwing the clutch back into contact with the slow-speed pulley, thus reducing the speed to the proper number of revolutions per minute for milling out the second arc of metal left in the groove by the roughing cutter. The manufacturer claims that two of these machines have a capacity for rough- and finish-milling 3000 fuse rings a day.

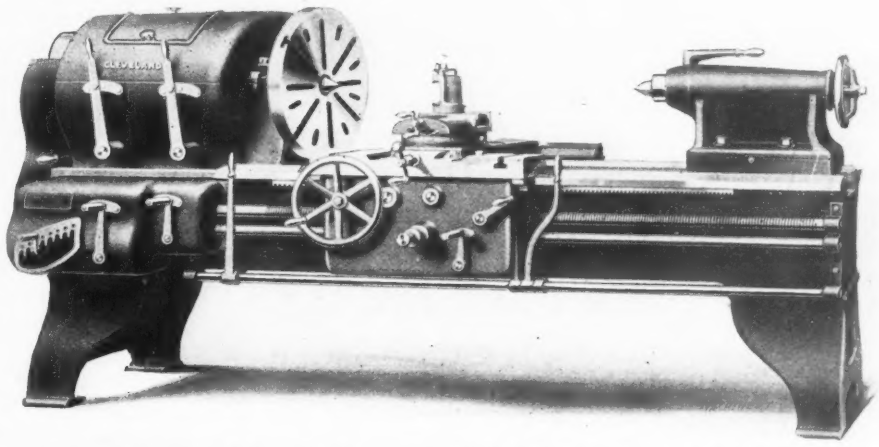
RICHARDS-WILCOX TROLLEY OVERHEAD SWITCH

The chief claim made for the trolley overhead switch that forms the subject of the following description is that the design has been worked out to make the switch as compact as possible. It frequently happens that this is a matter of great importance because economy of space is absolutely necessary in many congested factories. The accompanying illustration shows a section of straight and curved track with a three-way switch, but the same type of switch is made in a two-way type. Both types are made for use with two sizes of track; they are provided with a positive locking attachment and finished with japan. This switch is a recent product of the Richards-Wilcox Mfg. Co., Aurora, Ill.

CLEVELAND ENGINE LATHE

The accompanying illustration shows the 20-inch size of a line of heavy-duty single-pulley drive engine lathes with quick-change gear-box and all-geared head, which have recently been added to the line of the Cleveland Machinery & Supply Co., Cleveland, Ohio. The machines are of heavy construction, making them suitable for all classes of heavy work within their range, although they are particularly adapted for the requirements of automobile and forge shops. The bed is of the box-section type and has a large compensating vee at the front and a flat way at the rear. The headstock is of the geared type with single-pulley drive, and nine changes of speed are available, which are obtained by operating two levers. All gears are made of steel and the single pulley is equipped with a powerful friction clutch operated from the front of the machine, either at the headstock or apron as desired. All bearings, including the spindle bearing, are lined with bronze; and the spindle is provided with a ball thrust bearing.

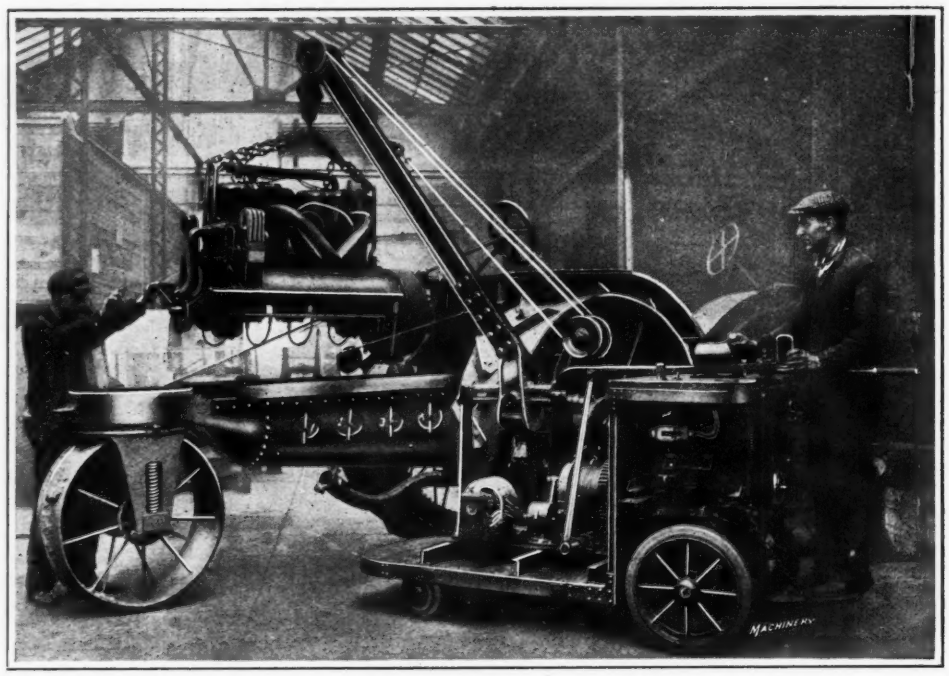
The carriage is gibbed front and back, and has a bearing on the bed through its entire length. The cross-slide and compound rest both have taper gibs to afford compensation for wear; and both the front and back wings of the carriage have felt wipers to protect the vees. The apron is of heavy



Cleveland Machinery & Supply Co.'s Heavy-duty 20-inch Engine Lathe with Single Pulley Drive and Geared Head

box section, with all gears made of steel and all bearings lined with bronze. The bearings in the back wall of the apron are oiled from a single reservoir, which is reached from the top of the carriage. Only one friction is used for operating both the longitudinal and power cross-feed; and automatic stops and reverse for the feeds are furnished. The apron is equipped with a safety device that prevents engaging the half nuts without first throwing the feed lever in the central position. As a result, it is impossible for the operator to engage both the lead-screw and feed-rod at the same time.

The quick-change gear-box is of the familiar cone type of construction, and it is equipped with all steel gears and bearings lined with bronze. The driving mechanism for the lead-screw and feed-rod is arranged so that the two cannot be engaged simultaneously. These machines may be equipped with a taper attachment, four-tool turret toolpost, heavy hexagon carriage turret, and power feed bed turret. When so desired, they may be provided with alternating-current or direct-current motor drive; and the motor may be direct connected through gearing or the power transmitted by a silent chain, as desired. Reverse to the spindle can be supplied at any time either for belt or motor drive. These lathes are made with 18, 20, 22, 24, 26, 28, 30, 32 and 34 inches swing, and with any desired length of bed.



Crane Truck built by Elwell-Parker Electric Co.

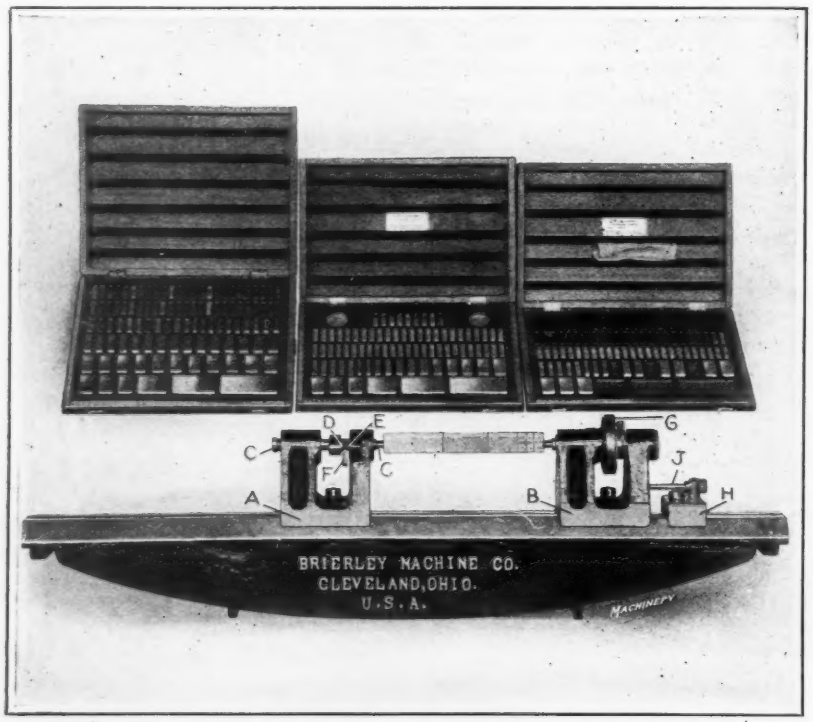
ELWELL-PARKER CRANE TRUCK

The Elwell-Parker Electric Co., Cleveland, Ohio, has recently added to its line of industrial trucks the "rocking" type of crane truck illustrated and described herewith. The boom and hoist are motor driven by an Elwell-Parker crane type motor, which receives energy from the same storage battery that furnishes power to the separate propelling motor; and the arrangement is such that the operator does not need to leave the driving platform to raise the boom or hoist the load. In handling automobile engines between inspection, test and installation on the chassis, this crane has a decided advantage due to its being mounted on a "four-wheel-steer" truck that may be driven into very close quarters to deliver the load in exactly the required position. Trucks of this kind are also employed for handling heavy dies used on drop-hammers, for lifting castings onto or off the planer, and for a great variety of other lifting work which must be done in industrial plants. Those experienced in the employment of labor know that it is difficult to secure men for doing just this class of work, and one truck has the capacity of a number of men. The capacity is for lifting work up to 1000 pounds.

BRIERLEY PRECISION MEASURING MACHINE

A precision measuring machine in which the pressure of measuring points on the work is controlled by the dropping of a plug is shown in the illustration. The machine is built by the Brierley Machine Co., 1736 E. 22nd St., Cleveland, Ohio, and is used for handling this company's own work. It consists of a heavily ribbed bed on which are carried two adjustable slides *A* and *B*. Slide *A* carries the pressure mechanism, which is of simple design; at the rear of sliding spindle or measuring point *C* there is a spring (not shown) which exerts a pressure of 6 pounds. Attached to spindle *C* is a yoke that carries a point *D* located in line with stationary point *E*, which is supported by the frame of slide *A*. Between these two measuring points is a plated rod *F*, which drops when pressure applied to the work by the measuring point reaches 6 pounds.

Slide *B*, located at the other end of the base, carries a measuring spindle provided with a screw having forty threads per inch. On this screw is mounted graduated ring *G* that is divided into 250 spaces, and a pointer attached to slide *B* facilitates the taking of readings on graduated ring *G*. The measuring machine can be set with Johansson blocks, as shown, and the dial *G* set so that it records zero. Then the work to be measured is placed between the measuring points, and if larger than the blocks the pressure will, of course, be greater on the sliding spindle *C* and will cause the plug *F* to drop out.



Precision Measuring Machine developed by Brierley Machine Co. for gaging its own Work, and now built for Market

For the purpose of making rough adjustments of the position of slide *B* on the base, an additional block *H* is provided which has a screw *J* operated by a knurled head. It will be evident that as the pitch of the measuring screw is 1/40 inch and graduated dial *G* is divided into 250 spaces, direct readings can be made on the machine to 0.0001 inch. But the spaces on dial *G* are sufficiently wide so that it is an easy matter to estimate readings to 0.00001 inch with a high degree of accuracy. The machine has a capacity for measuring work up to 26 inches in length.

GREENFIELD "GUN" TAP

The term "gun" tap, which is the name by which this tool has been familiarly known during the time that it has been in process of development, was derived from the fact that it was originally designed for use in gun shops. On account of the exceedingly tough and wiry material used in this class of work, ordinary taps were very likely to break. The name,

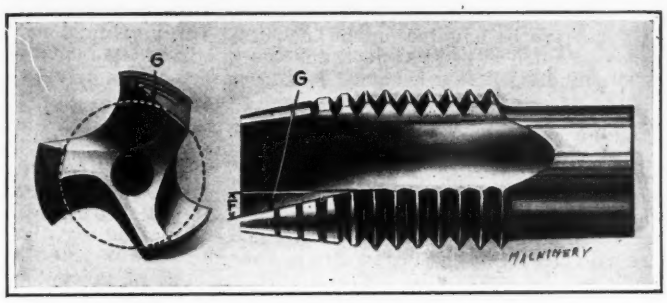


Fig. 1. Close View of "Gun" Tap made by Greenfield Tap & Die Corporation

however, should not be confusing, as this tap is designed for all kinds of materials and work.

Reference to the accompanying illustrations will show the differences in construction from an ordinary tap. The cutting edges *G* at the point are ground at an angle *F* to the axis of the tap in order to cut with a shearing action. This throws

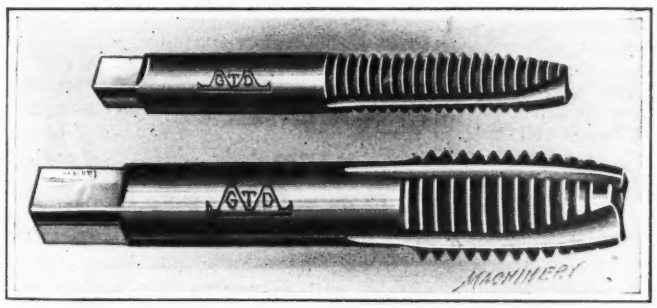


Fig. 2. Two-fluted and Three-fluted Greenfield Gun Taps

the chips, unbroken, ahead of the tap instead of allowing them to collect in and clog the flutes. The two- or three-flute construction is thus possible, and much shallower flutes can be used than is possible in the ordinary tap. The "gun" tap has almost the strength of solid stock, and this strength, combined with the easy cutting qualities, makes a tap which practically never breaks. If the gun tap should break, due to either carelessness of the operator or some unnatural condition of the stock, it will only chip off the sharp cutting edge, which

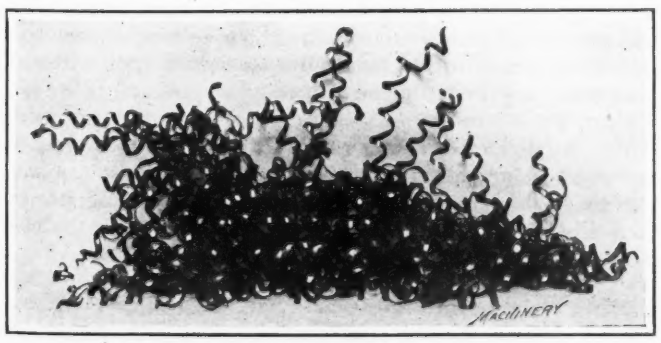


Fig. 3. Chips made by Greenfield Gun Taps

can be easily reground.

The gun tap does all its cutting on the first few teeth. The rest of the thread acts as a lead-screw, steadying the tap and producing a very accurate thread. This enables the tap to hold its size very close in all materials. It is ground on the angular cutting edge instead of in the flutes, as in the case of ordinary taps, and can be reground repeatedly until there are only three or four full threads left, and will maintain its size to this limit.

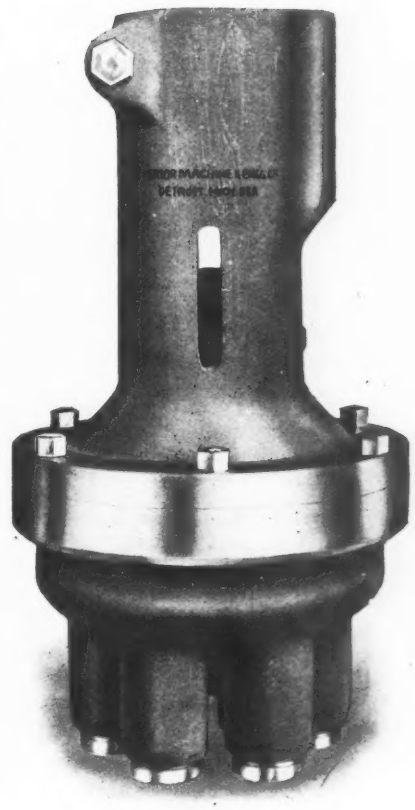


Fig. 1. Six-spindle Superior Drill Head

A simple gun tap can be used in many places where two and three taps, used successively, have formerly been required, as the free cutting qualities of the gun tap permit working under much more difficult conditions and in tougher materials than is otherwise possible. One instance where the gun tap proved valuable was on a job where it was necessary to tap a small hole, drilled at an angle, through two kinds of material of different degrees of hardness. This proved a puzzling problem, as each tap that was tried broke as soon as it struck the second layer of metal. The gun tap was tried and worked perfectly, tapping hole after hole with perfect ease. These taps have recently been added to the line of tools manufactured by the Greenfield Tap & Die Corporation, Greenfield, Mass.

SUPERIOR DRILL HEAD

The outstanding feature of the multiple-spindle drill head illustrated and described herewith is the simplicity of its design and adaptability for a variety of work. The central drive consists of an internal gear attached to a driving shank made to fit the machine spindle, which gives the correct speed for the drills without the use of intermediate gears. Provision is also made for increasing the speed, which is very desirable in cases where small drills are to be used on a heavy machine. The spin-

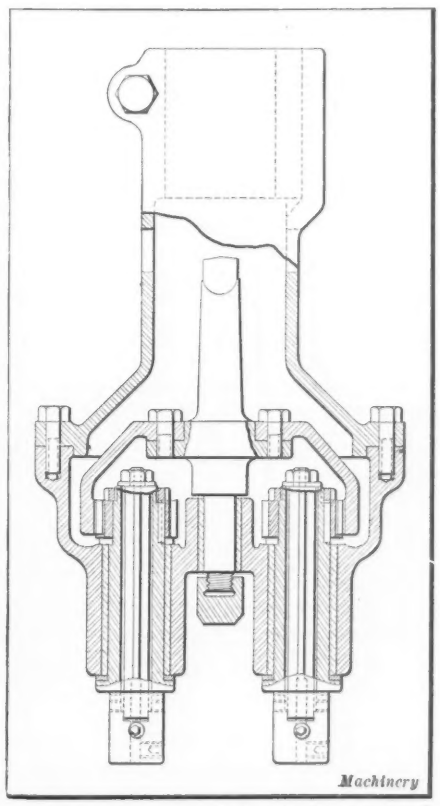


Fig. 2. Cross-sectional View showing Arrangement of Internal Gear Drive

dles may be made either fixed or floating and adapted for drilling and tapping operations. It will be noticed that the gears are completely enclosed in a housing which is designed to form an oil bath, thus giving maximum life to the gears and ample lubrication for the spindle bearings. This drill head is a recent product of the Superior Machine & Engineering Co., 51-53 Fort St., E., Detroit, Mich.

NEW MACHINERY AND TOOLS NOTES

Heavy-duty Pulley: Medart Patent Pulley Co., St. Louis, Mo. A heavy-duty pulley of light weight, in which the arms are made of flat wrought steel, and the hubs and rim lugs of semi-steel that is cast to the end of the arms which are formed to produce a solid anchorage.

Electric Crane: Whiting Foundry Equipment Co., Harvey, Ill. An exceptionally large alternating-current electric crane built for handling locomotives in the new shops of the Seaboard Air Line, Portsmouth, Va. This crane has a capacity of 160 tons and there are two 80-ton trolleys, one of which is equipped with a 10-ton auxiliary hoist.

Storage Battery Truck: Elwell-Parker Electric Co., Cleveland, Ohio. A storage battery truck provided with a hopper to make it suitable for carrying small castings, chips, foundry sand and any other form of loose material. The hopper may be arranged to dump from either the end or the side. Trucks of this kind are made with hoppers having capacities ranging from 22½ to 36 cubic feet.

Boring Lathe: Osborne & Sexton Machinery Co., Columbus, Ohio. A heavy-duty machine for boring 6-inch shells. The bed is of heavy construction and is 12 feet, 6 inches in length; it is provided with double-webbed box type girths to eliminate vibration. The machine swings 40 inches, and a hole 4½ inches in diameter by 12¾ inches deep can be bored in a 6-inch solid shell billet in twenty-five minutes.

Straightening Press: John T. Towsley Mfg. Co., Cincinnati, Ohio. This machine is provided with V-blocks, the distance between which may be adjusted to suit the work. By using pieces of copper in the V-blocks and under the screw head, tools and finished work are rapidly and easily straightened without marring the surface. The capacity is for work up to 2½ inches in diameter by 48 inches in length.

Belt Clamp: Cleveland Fabric Belting Co., Cleveland, Ohio. A safety clamp for use in taking up slack in belts and for lacing them. Each side of the clamp is provided with a swing bolt which enables the clamp to be quickly attached to a slack belt or slipped over the ends of a broken belt. Then the two ends of the belt are drawn together by a rack and pinion which actuate the movement of the two clamps.

Seam Welding Machine: Toledo Electric Welder Co., Langland and Knowlton Sts., Cincinnati, Ohio. A motor-driven seam welding machine especially adapted for welding the side seams of coffee pots, pails, phonograph horns and similar products. The stock overlaps from 1/32 to 1/8 inch and the pressure of the rolls forces it together so that the thickness is only 0.002 to 0.003 inch greater at the joints than at other points.

Vertical Milling Machines: Becker Milling Machine Co., Hyde Park, Boston, Mass. The general features of design of both of these machines are similar to those of the high-powered continuous milling machine previously built by this company. Both machines are equipped with rotary tables so that suitable fixtures for the performance of continuous milling operations can be used. One is a single-spindle machine, while the other machine is provided with two spindles.

Electric Furnace: Electric Furnace Co., Alliance, Ohio. An electric heat-treating furnace on which a patent was granted to T. F. Bailey and to F. T. Cope, and assigned by them to the above company. The material to be heated rests on a hearth and the heat is reflected down onto it from a brickwork arch. At each side of the hearth there are spaces filled with granular coke or charcoal which forms the resistance members, the electrodes being located at the end of these charcoal filled chambers.

Plain Milling Machine: Kempsmith Mfg. Co., Milwaukee, Wis. An improved model of the No. 33 milling machine formerly manufactured by this company. The design has been modified to meet conditions met with in manufacturing the machine and in using it. Changes in the rate of feed and speed are made by means of change-gears which are enclosed in a single gear-box. Narrow guides are used on the column. The floor space occupied by the machine is 64 by 106 inches, and the net weight is approximately 4500 pounds.

Marking Machine: Martin Machine Co., Greenfield, Mass. A hydraulic machine designed for marking round or flat surfaces. The work is placed on a table and raised into contact with the marking die. The table adjustment is provided with a set of ball bearing thrust collars which relieve the lock-nuts of pressure, leaving them free and easy to move by a slight turn of the hand. The maximum travel of the slide is 8 inches; maximum adjustment of table, 6 inches; floor space occupied, 30 by 24 inches; and weight of machine, 950 pounds.

Gage Grinding Machine: Gem City Machine Co., Dayton, Ohio. A machine especially designed to meet the requirements of tool-room work. The Gem City Machine Co. does a large business in making punches, dies, and gages, and designed the machine with especial reference to handling this work, for which purpose the machine proved so successful that it was decided to build it for the market. The table which is 6 by 14 inches in size swivels through an included angle of 20 degrees. The table traverse is 4¼ inches; adjustment of grinding head, 12 inches; cross-feed lever movements, 3 inches; and weight of machine, about 700 pounds.

Universal Grinder: Thompson Grinder Co., Springfield, Ohio. The design of this machine follows that of this firm's former grinding machine in general features, but certain details have been changed to make the operator's work easier or to meet special conditions that have been discovered since the original design was worked out. The capacity is for grinding cylindrical work up to 10 inches in diameter by 36 inches in length, and for surface grinding work up to 8 inches in width by 48 inches in length. Internal grinding up to 12 inches in depth can be handled on the machine. The maximum floor space occupied is 11 by 11 feet, and the weight of the machine, 3600 pounds.

Alloy for Cutting Tools: Darwin & Milner, Inc., 281-283 Water St., New York City. An alloy known as "Reactal" which is suitable for use in making cutting tools for machine tools. This material is offered as a substitute for the best grades of high-speed steel and is said to be tougher than stellite. It is cast in bars of any required size and does not require heat-treatment, the tools being ready for use after grinding. Bars are provided of any required size so that the work of grinding tools can be done with the minimum amount of labor cost. At the present time this company is working on a method of casting such tools as milling cutters so that they are of the required form and the only grinding required is to sharpen the cutting edges.

Welding and Cutting Torches: Bishop-Babcock-Becker Co., Cleveland, Ohio. A new line of oxy-acetylene welding and cutting torches. The welding torch is equipped with two needle valves which are conveniently located beneath the handle to provide for governing the pressure. The mixing chamber is designed to reduce danger of back-firing to a minimum. The oxygen has a straight passage from the inlet tube to the tip, and the acetylene enters an annular cavity in the mixing head and is fed through small ports into the mixing chamber. In the cutting torch, the acetylene is controlled by a needle valve and passes through five holes in the tip which surround the oxygen opening. The oxygen is controlled by a thumb valve at the top of the handle. The torch is made of brass and is 24½ inches long.

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APPARATUS FOR HEAT-TREATING MAGNETIC METALS

Prof. R. B. Fehr of State College, Pa., has been granted a patent on a method of and apparatus for giving heat-treatment to magnetic metals; that is, iron and its alloys, such as carbon and other steel. Carbon steels which hold in solid solution iron carbides in the form of austenite, martensite, troostite, osmandite and pearlite, when cooled from a molten condition, show a sharp jog in the cooling curve known as the recalescent point, where heat is given up by the molecular changes in the ferrite and carbides. Conversely, when steel is heated up, reactions again occur and heat is absorbed, the jog on the heat curve being known as the decalescent point. The usual treatment of steel consists in heating it through its critical range represented by the two points mentioned, and noting the temperature by the indications of a pyrometer, to ascertain when these points are attained. But the decalescent and recalescent points do not coincide, on account of hysteresis and other causes, within from 20 to 50 degrees C., the decalescent point always being the higher.

Prof. Fehr's invention provides a method and means by which the decalescent point can be quickly and accurately determined. The method consists in heating the steel and causing a magnetic flux to pass through it from a point outside the source of heat, and indicating the difference between the magnetic induction and the residual magnetism.

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Never mark with white chalk on finished cast-iron surfaces. The chalk will rust the iron and will persist for years after all traces have been apparently wiped off.

POST WAR TRADE AGREEMENTS

METHODS TAKEN BY EUROPEAN NATIONS TO OBTAIN PART OF THE WORLD'S TRADE—AMERICAN DYE CONDITIONS—ONE OF RUSSIA'S SOURCES OF STRENGTH

DURING the past month, the British government approved the resolutions passed by the Paris Economic Conference of representatives of the Entente Allies. These resolutions provide for an economic war to succeed the war now in progress and are in line with the recommendations of many of the British commercial bodies. They are also in line with the policies of Great Britain as far as it has been able to carry them out. The results of these policies on the commerce of these nations, though, may prove more harmful than the nations think. In fact, many of the English leaders are admittedly against these recommendations claiming that they will work great harm. Many are loud in their denunciations of them and demand that there be no change in the fiscal policy of the nation. Some say that to accept these plans is to confess the failure to obtain that for which Great Britain says it went to war—the destruction of Prussian militarism. Others think that the only results of such plans will be the building up of a stronger German competition than before. J. A. Hobson, the English economist, said, "To stop the trade of Germany would be to stop her wealth, and the recoil would be equal to the blow."

These plans are only an extension to its allies of the policies that have governed trading with the various parts of the British Empire. Laws compel the Australian and New Zealand governments to favor local manufacturers in the purchase of supplies even though the local is inferior to the foreign. Great Britain and its colonies are then given the preference by the tariff laws over all other lands. Yet when the effort has been made, American goods have won a place from which it is difficult for all other goods to displace them. If these plans carry, some of the allies may find themselves in the position of the Germans when they got possession of the rich Shantung district of China. They caused the Chinese government to make a treaty by which the Germans were to be given preference of all trade in that region and no trading could be done with any people unless the Germans had first refused it. But Germany was never able to put the conditions into force, for it knew that as soon as it did, it would be shut out of the trade with those parts of the Chinese Empire in which the French and British influences predominated.

Speaking of this conference, the *Hamburger Nachricten* says:

> We therefore express no opinion about the intention of the allies to impose special conditions on the shipping of their present foes, or on the permanent measures England and her friends propose regarding raw materials and manufactured articles which they could hitherto only obtain from Germany. Events will surely take a different course than the theorists gathered around the Paris conference table imagined. Let our enemies remember once for all that war is only ended on the basis of negotiations, and that the victorious side is easily in position at the signing of peace to slash to pieces with its sharp sword such paper agreements as those to which it has neither assented nor is inclined to assent.

Germany's most forceful answer to these plans is the formation of stronger combinations for the carrying on of her trade. Sixty thousand men are included in the engineering association just formed to foster German trade at the end of the war. Besides, the older associations are strengthening their organizations and recently a company was formed to sell coal in the Balkan states and Turkey where England has been sending 2,500,000 tons annually. The Germans are also resenting the action of the London Chamber of Commerce when it expelled all Germans from its membership, even those that had become British citizens.

Count Kokovtsev of Russia, president of the Council of Ministers, a position corresponding to that of prime minister of England, in a recent interview said:

> It has been said that, financially speaking, I have been friendly to Germany. This is not true, but I realize that after the war, in a few years perhaps, people will turn to Germany if other nations are harsh and excessive in their demands, if they ask too much interest, and if Germany pursues the sensible and astute commercial policy she did before the war of giving people what they wanted, of good quality and on convenient terms. If a peasant wants an agricultural machine somewhere in Siberia, do you think he will pay cash for it, especially if he needs the money for other things, when he can get a good quality machine on long credit and from a company which keeps plenty of spare parts constantly on hand in warehouses situated conveniently for him to obtain without delay? I do not mean that Germany will obtain her former position with us as regards agriculture and land owning in Russia, for there will be laws to prevent that, but commercially and industrially she will come back if the other nations let her.

Many of the nations entering into this agreement will find it most embarrassing later because of their other agreements and arrangements. The French Society for Commercial Development, which has a capital of $100,000,000, has been formed to "bring the commerce of the United States into direct touch with that of France." Its principal object is to eliminate all middlemen and brokers so that buyers on both sides may deal directly with the producers. The American representative, Dr. Arnaud Rosenthal, says, "The society will build a line of ships that will sail direct from the United States ports to those of France. There will no longer be the stop in England with the English commissions to pay. Plans for these vessels are already under way and before the end of the war the first of them will probably arrive in New York."

Another international agreement that may cause trouble, if the recommendations of this conference are carried out, is the treaty between Russia and Japan relating to the Chinese Republic. In their discussion of this treaty, some people call attention to the fact that Japan, outside of strengthening herself in Asia, has done nothing to gain the enmity of Germany, and they claim that as soon as the war is over the two nations will be allies on the far eastern question. These people claim that there is friction between the Japanese and the English and that the British are jealous of the success of their Eastern trade rival and that the Japanese resent the restrictions that the British are putting on their trade. They also point to the fact that Japan and Germany are keen commercial rivals of the United States and will therefore unite against a common commercial rival.

Both Russia and Japan are seeking to obtain the privilege of developing the resources of China. As Siberia is being developed, Russia will want both markets and supplies from China, so that the interests of the parties to this treaty are inimical.

Effect of Recommendations on Russia

The nation that will suffer most from these recommendations is Russia. That nation is just awakening to its greatness and its people are just beginning to realize the conditions under which they have lived. Wages in the textile industries have increased nearly one hundred per cent during the past sixteen months. Savings deposits have grown so rapidly that the banks are astounded at their amounts. The scale of living is changing so quickly that the people will never be satisfied with their former life. Plans are being made to develop the natural resources on the most economical basis possible. These resources consist of 250,000,000,000 tons of coal and countless million tons of iron, copper, gold, silver, platinum, lead, manganese, mercury, nickel, and other metals. Besides Russia's oil fields stand second in the world, and are only partly developed, while its forests cover one-fourth of the empire's area. Although it has a most extensive system of canals, these are now being augmented by thousands of miles of railroads, so that goods can be transported irrespective of weather or seasons. Thousands of miles of new roads are being planned and built for the development of different parts of the empire.

One of the greatest factors in the awakening of Russia, and one that will take a most important part in its development is the cooperative society. Speaking of this factor, Nicholas

Tchaykovsky, a member of the Central Cooperative Committee of Petrograd, recently said:

And despite the war our cooperative societies are growing at a wonderful rate. In one district alone the number of cooperative unions has grown since the war from 50 to 302. We had only forty wholesale societies last year. Now there are over 400. In 1911 there were but eleven credit unions in all Russia, whereas at present there are over sixty through which about 10,000 separate cooperative credit societies are working. Our Moscow, or mother, committee alone is coordinating the work of more than 2000 groups, each group composed of several societies. We have organized a Central Cooperative Credit Bank in Moscow which has its own office in London executing our foreign orders, buying and selling. The Siberian societies have their own bank in London.

We are branching out in every direction, building our own flour mills, starch works, oil plants, machine shops and so on. We are going to start paper and sugar mills. At Staro-Bardinsky, in Siberia, we have our own light plant giving the inhabitants electricity for a dollar a year. Over forty papers in Russia are devoted exclusively to our work. In conjunction with the Zemstvo Union we are helping Russia and the Allies. Since the beginning of the war Siberia alone has furnished the army with 31,000,000 pounds of butter, with thousands of tons of hay, with lard, oats and other supplies, in all about $7,000,000 worth,

American Trade in Argentine

The *China Press* of Shanghai, recently had the following interview with Commander Jorge Yalour, of the naval training ship *Presidente Sarmiento*, of Argentine:

The foreign trade of the republic has been affected by the war, as the Argentine cannot obtain goods from Europe. But the United States is now covering the whole field that the European countries formerly covered. The friendly relations of the United States and Argentine are increasing day by day. Trade is pouring in from all parts of America, and during the last year and a half the number of branches and establishments of American firms founded all over the republic has been large. The National City Bank of New York is doing a great business with its chief branch at Buenos Aires, and branches are also being established all over the country. The greatest quantity of imports during 1914-1915, as well as this year, has been supplied by the United States.

Miscellaneous Notes

Much has been written of the visit of the German submarine to Baltimore, but the real purpose of that visit has been ignored. Its consignment of dyes showed that Germany was becoming greatly alarmed over the prospects of losing its rich dye markets, as the American manufacturers of coal tar and natural dyes are rapidly increasing their exports.

Italy, which in April was the largest buyer of American colors, as reflected by the New York exportations, in May yielded first place to Russia, which took colors worth $260,720, Italy coming next with purchases set down at $105,645. English requirements reached $62,516. In spite of the disturbed conditions in Mexico, New York color shipments to that country in May were returned at $41,500. France's share was $29,587, and that of Spain $24,251. Brazil took colors worth $13,334; Argentine, $13,172; Chile, $5904; other South American countries between $2000 and $3000 worth each, while Ecuador's purchase here made the rather unimportant total of $1. Portugal purchased $11,177 worth while Greece's purchases were valued at $7027. Scottish shipments footed $3443, British India $1240, and Japan $722. Australia bought American dyes valued at $1281, while fair purchases were made by Cuba and the West Indian Islands generally.

England, too, is seeking to retain its trade, but is doing it largely by means of the boycott, mail seizures, and discrimination in freight rates. The blacklisting of eighty-two American firms is condemned by all as an unwarranted interference with American trade. Notwithstanding its promises to expedite the mails and its claims that it does not interfere with the trade between neutrals, American commercial associations are daily receiving evidence that it does. For instance, a letter mailed in Stockholm on March 7, as shown by the postmark, was not received by the addressee in New York until June 20. In the meantime, the sender sent several cablegrams and a letter to the addressee, none of which he received.

A sewing machine advertisement in a Hamburg newspaper indicating the temper of German interests follows:

Germans! Remember that American factories supply our enemies with munitions to kill our sons and brothers or to make them cripples. Were it not for the war material thus delivered to our enemies the war would have been finished many months ago. Buy only real German sewing machines. Protect thereby the German workman and the German sewing machine industry, which provides 60,000 persons with bread. Take care to keep the money in the country. D. E. J.

* * *

SHARPENING MILLING CUTTERS

A milling cutter deteriorates rapidly if it is used when dull, and a slight amount ground off to sharpen it prolongs its life. The selection of wheels for grinding cutters is of importance. In grinding the cutter, the temper of the cutting edge should not be drawn. Hence, a soft, free cutting grade of wheel should be used with as light a feed as possible. It is a common fault to use a wheel that is too fine, and for most cases a medium wheel about grain 46 and never finer than grain 60 is best suited for high-speed steel and carbon steel cutters.

Some operators prefer to use a cup wheel, as the periphery of a regular wheel leaves the clearance of the teeth slightly concave or hollow, and it is the contention that concave teeth become dull sooner than those having a straight angular relief. This defect may be overcome by swinging the table of the machine so that the work passes across the wheel at an angle instead of parallel to the face. However, the concave effect is of little consequence unless the wheel is less than 3 inches in diameter. It is wise to use as large a wheel as possible.

The wheels most commonly furnished by the Norton Co. for grinding milling cutters are alundum, grain 38-46, grade J and K, and alundum, grain 38-60, grade I. Both vitrified and silicate wheels have been found to be very satisfactory for shapes such as Brown & Sharpe No. 60.

Practice varies as to the direction in which the wheel should run. It is safer to run a wheel off the cutting edge, especially when the operator is inexperienced. When cutter grinding machines are constantly used and experienced operators attend to them, the wheel is often run toward the cutting edge instead of away from it with good results. By this method there is less danger of burning and a keener cutting edge is produced.

To equalize the wear on the wheel, it is the practice among some cutter grinders to grind completely around the cutter, then revolve it half way, starting anew on a tooth just opposite the original starting point, and take another cut all the way round. By repeating this method and taking light cuts, the wheel wear is equalized and a cylindrical cutter is produced. Under favorable conditions the cut may be 0.003 inch, but the average cut should not be more than 0.001 or 0.002 inch. A very light finishing cut should correct any slight error. Ordinarily twice around will put the cutter in good condition.

The angle of relief on the cutter should be sufficient to allow it to work freely. The common practice is to allow an angle of between 4 and 5 degrees clearance. The amount should depend, however, on the material upon which the cutter is to work and the diameter of the cutter. Four degrees for plain milling cutters over 3 inches diameter has been recommended, and 6 degrees for those under 3 inches diameter. Too much clearance will cause vibration in operation.

Form cutters are generally ground with a saucer type alundum wheel, grain 38-60, grade J and K. For grinding gear-cutters, the wheel recommended is grain 38-46, grade K, although grain 38-50, grade J, is used to a large extent. A satisfactory wheel for inserted milling cutters is grain 38-46, grade J and K. Under some conditions, it may be found necessary to use a coarser wheel or grain 38-36, grade I.—*Grits and Grinds.*

* * *

A broken tooth in a tap does not make the tap useless. As a matter of fact, if all of the broken tooth is carefully ground out, leaving no jagged edges to tear the thread, the efficiency of the tap as a threading tool has been reduced but slightly. A tap will do the work required of it as long as there are three good threads left, and the man who has the habit of throwing away broken taps that can so easily be put into working condition again needs to be taught this principle of economy.—*Grits and Grinds.*

HIGH BULLET VELOCITIES

A rifle bullet fired horizontally begins to fall toward the earth as soon as it leaves the muzzle. The effect of gravity is exactly the same on a horizontally moving bullet as on one falling freely. If a bullet were suspended by a thread at the muzzle of a rifle so that the thread would be cut by a bullet fired in a horizontal direction over a level plane, the bullet fired would strike the ground, theoretically, at the same moment that the bullet suspended by the thread reached it immediately beneath the muzzle. Elevating the sights is the means employed to counteract the effect of gravity so that the bullet will strike the point at which it is aimed. The sportsman actually points the bore of his rifle at a spot considerably higher than the target he wishes to hit when firing at a range of 200 yards. The elevation of the sights results in carrying the bullet to a height that compensates for the free fall in the time required for the bullet to reach the target.

The efforts to minimize the effect of gravity on rifle bullets have resulted in greatly accelerating muzzle velocities. Twenty years ago, the velocities obtained with black powder cartridges were about 1300 to 1400 feet per second. These velocities meant high trajectories in long-range shooting, and great care had to be taken in estimating distances and setting sights when shooting at ranges greater than 150 yards. Smokeless powder made a great change, the muzzle velocities being raised by its use to 1800 to 2200 feet per second with corresponding flattening of the trajectories. With smokeless powder cartridges, the sportsman could set his sights at point blank range at all ranges up to, say, 200 yards.

But these velocities are considered comparatively slow now. Improvements in barrel making and powders have continued, and sporting cartridges are now available which give muzzle velocities to Spitzer bullets of 3000 to 3100 feet per second, the trajectories being so low that no adjustment of sights is required for big game shooting at distances less than 300 to 400 yards.

Some sporting and military enthusiasts are claiming that velocities of 3500 to 4000 feet per second will be realized in the near future, their predictions being founded on the improvements in barrel steels and powders that will be made as a result of the experience in the great European war. But it is well to bear in mind what the velocity of 4000 feet per second means as compared with one of 3000 feet per second. Given two cartridges loaded with bullets of the same weight, the cartridge that would propel its projectile at the velocity of 4000 feet per second must develop nearly twice the energy of that required of the 3000 feet per second cartridge, inasmuch as the energy of a moving body increases as the square of the velocity. This means that breech pressures must be greatly increased and probably will reach 65,000 to 70,000 pounds per square inch if the dreams of the enthusiasts are realized.

There is, of course, the possibility that some means may be discovered by which a bullet of comparatively small caliber may have expended on it the energy of a large powder charge without involving very high breech pressures. The bullet might be centered by wings or flanges in a comparatively large bore and propelled by the gases without loss of pressure. The wings or flanges that fitted in the bore would have to be instantly dropped at the muzzle in order to minimize atmospheric resistance, and would have to be very light in order that a large percentage of the effort of the propelling charge would not be wasted in giving them the required initial velocity.

Or the bullet might be made with a longitudinal hole tapering each way from a cross-section near the head end. The shape of the longitudinal section should be somewhat like that of a double injector tube or expanding nozzle. This hole would be packed at the base with a slow-burning powder, highly compressed, and so graduated that the plug would be consumed shortly after the bullet left the bore. With this form it would be possible to give a 0.303 bullet about the same head resistance in the air as a 0.22-caliber bullet, while it would be propelled by the pressure on the base of 0.303 diameter. The possibility of greatly increasing muzzle velocity with present breech pressures is obvious.

NON-RECOIL GUNS FOR AEROPLANES

The rapid development of the aeroplane for military purposes has made it necessary to consider the question of providing it with a suitable weapon of defense. The two factors that limit the power of the armament for aeroplanes are the force of the recoil and the weight of the weapon. In order to overcome these limitations, the non-recoil gun has been developed, and its tests have thoroughly demonstrated that, regardless of the caliber, there is practically no recoil force. The absence of recoil is due to the fact that instead of having the gun closed at the breech end, it is left open by substituting a complete barrel for the usual breech-block, and firing through this barrel to the rear a charge of fine shot (equal in weight to the front projectile) that quickly scatters and loses its velocity. In this way the action and reaction are of equal force, so that there is no tendency for the gun to move in either direction. The powder charge is so arranged that it is all in one chamber, and the ignition and combustion of the two charges are necessarily simultaneous.

The elimination of the shock of the recoil makes it necessary to consider only the question of weight in limiting the size of an aeroplane gun. This weight has been greatly reduced by a departure from the usual method of gun design and by the adoption of the most suitable material in its construction. The material used for the barrels of all non-recoil guns is chrome-vanadium steel, having a minimum elastic limit of 100,000 pounds per square inch after heat-treatment. It might seem that the necessity for using two barrels in this type of gun would present a considerable handicap in the matter of weight, but this is readily overcome by the use of vanadium steel, thus permitting barrels to be used that, although having a larger factor of safety than is customary in ordnance work, are yet very thin as compared to barrels made of other materials. An as example of the reduction in weight, it may be stated that the six-pounder Mark IV gun complete weighs only 103 pounds. This gun has an over-all length of 10 feet, and on its proof test developed a muzzle velocity of about 1100 foot-seconds with a chamber pressure of 7.53 tons per square inch. The maximum thickness of the barrel in this gun is 0.470 inch over the chamber, while near the muzzle the thickness is reduced to 0.102 inch. The maximum fiber stress in the barrels on firing was somewhat over 52,000 pounds per square inch.

The two-pounder Mark II gun of this type has the lightest barrel ever used in any gun of equal caliber. The bore of this gun is 1.575 inch diameter, and the maximum thickness of the barrel is 0.315 inch over the chamber, being gradually reduced to 0.078 inch near the muzzle. This gun has a muzzle velocity of 1200 foot-seconds and weighs 75 pounds. The guns mentioned are both breech loaders and use fixed ammunition. The two barrels are joined by interrupted threads and the rear barrel is kept in alignment with the front barrel by means of a rotating shaft held in place underneath the gun by having bearings in four bands; two of these bands are on the front barrel and are shrunk on so that they are not movable. The construction is such that the rear barrel rotates in its band when the breech threads are being unlocked and slides to the rear clear of the front barrel through the same band, and finally the rear barrel and band swing as a unit to the right about the rotating shaft as a center until brought to rest against a stop at the front spiral breech band. The complete operation of opening or closing the breech is effected by continuous pressure on an operating handle which is guided in its movement by a slot in the handle guide band.

The ammunition for these non-recoil guns resembles that used in the ordinary breech loading guns and the weapons are in reality light-weight, high-powered, quick-firing pieces of ordnance. Hundreds of these guns are now being built for foreign governments by the General Ordnance Co., Derby, Conn., five hundred men being employed exclusively on this special type of gun. The United States government has not as yet acquired any of these guns for its aeroplane service, owing to the fact that up to the present time the number of aeroplanes in the hands of the government has not been sufficient to warrant the purchase of these guns in any quantity.

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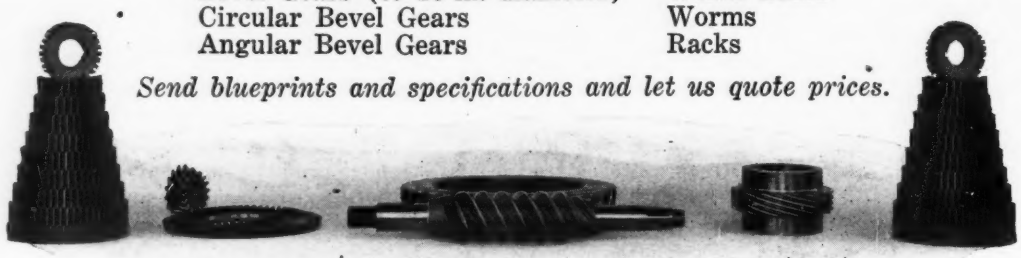

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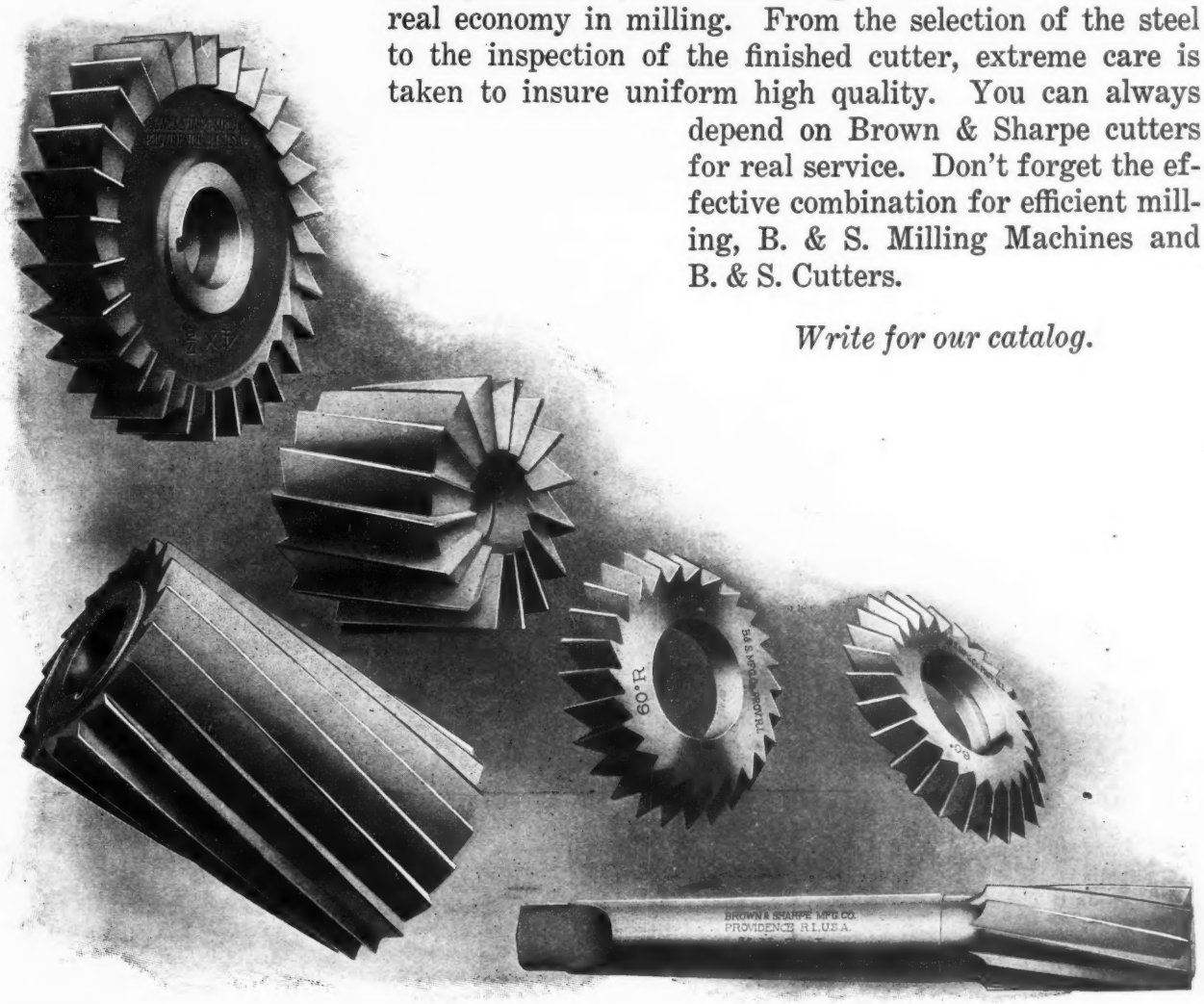

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VANADIUM STEEL BATTLE-PLANE

Vanadium steel has been found to be an important factor in the construction of every important instrument of modern warfare, whether as a protective armor, as a means of securing lightness with strength, or for making invulnerable some of the small but vital parts on which the highest efficiency of a piece of mechanism depends. Under the conditions created by military necessities in which nothing but the best is good enough, vanadium steel has come to be used to an extent which even the most optimistic engineers would have believed impossible in such a short time. The estimated production of vanadium steel in 1913 was 90,000 tons, while the estimate for 1915 placed the production at 450,000 tons.

One of the most recent and interesting applications of vanadium steel is the new armored battle-plane built for the United States government by the Sturtevant Aeroplane Co. In this new type of fighting machine, many novel features are employed, one of the important points being the fact that the entire craft, wings and all, is built from vanadium steel. The machine mentioned was designed by Grover C. Loening, formerly aeronautic engineer of the United States Army, and every detail has been worked out in the most conscientious manner so that this new machine may be considered as representative of the latest fighting aeroplane developments.

On the first model in which steel was used, the saving in weight as compared with wood construction was not great, but by careful refinement in detail and by utilizing to the fullest extent the exceptional strength of vanadium steel, the various sections were greatly lightened without a sacrifice of strength, so that in the later models the weight was reduced from 25 to 30 per cent. The class of vanadium steel used for the framework is cold-rolled stock, this being selected only after exhaustive comparative tests made by the Massachusetts Institute of Technology, of different kinds of cold-rolled steel stock. These tests proved conclusively the high merits of vanadium steel for the purpose. In addition to the cold-rolled vanadium sheet steel stock, it may be noted that vanadium steel wire is also extensively used. The new battle-plane was given the most rigorous test on its trial trip by Lieut. Byron Q. Jones, one of the United States government's foremost aviators. In these tests a straight away speed of 90 miles an hour was attained, after which the aviator "looped the loop" and made the "side-tumble."

An interesting feature of the machine is the standardization of the parts, so that it can be built in any size by the addition of units and installation of an engine of corresponding horsepower. Two armored gun turrets are provided to make up the fighting portion of the machine, one of these turrets being on each side of the torpedo shaped body where the pilot sits. The fighting men have an excellent view ahead and below and a clear range for gun fire on all sides, with the added advantage that the two guns can be concentrated for a broadside forward. By tilting the craft laterally, both guns may be fired at the same target on the sides. The engine used is 140 H.P.; the spread of the wings is 50 feet with 700 square feet of surface, and the length of the machine is 25 feet. Gasoline and oil tanks are provided having a capacity sufficient for an eight-hour flight, or roughly 800 miles. Armor protection against gun fire is provided for the pilot, and everything has been "stream-lined" to decrease the head resistance, this idea being even applied to the cables and turnbuckles. The capacity of the machine is a live load of 1200 pounds.

* * *

ASSOCIATION OF FRENCH IMPORTERS OF MACHINE TOOLS

The Chambre Syndicate des Importateurs Francais de Machines-Outils, or Association of French Importers of Machine Tools, has been incorporated under the French law with headquarters at 15 Rue Fenelon, Paris, France. The services of the association are offered to French importers and dealers, old or new, large or small, and it includes already some of the largest machine tool merchants. The association seeks by cooperation to improve and further develop the importation of American machine tools into France.

INERTIA OF FALLING BODIES

The effect of inertia on falling bodies is strikingly shown in the action of tall brick chimneys when overturned. They invariably break at some point between the base and the top, and the top portion falls much closer to the base than it would if the chimney remained intact. The cause is simply that all portions tend to accelerate in response to gravital pull at the same rate, but when falling in the arc of a circle the top must fall much faster than the base portion if the chimney remains whole—that is, it will sweep through an arc of greater length. But inertia prevents this, and the effect on the chimney in mid-air is the same as though it were a beam supported at both ends, and of course it breaks.

An accident recently occurred in a Corning, N. Y., glass factory which gave another striking illustration of inertia effect. A chimney about twenty-seven feet diameter at the base and 120 feet high was being repaired when it fell vertically eight feet, crushing the piers supporting it. The chimney was the flue of the furnace for melting glass in pots, and twelve pots were ranged around the base. Brick arched openings gave access to the pots, and the piers between supported the chimney. One of the piers was weakened by the workmen, and as it crushed, more weight was thrown on the other piers which also crushed, letting the chimney settle vertically into the furnace hole. The chimney did not overturn, as might have been expected, because the inertia effect delayed overturning long enough when one pier crushed to permit the others to crush also. After settling, the chimney stood about four feet out of plumb.

PERSONALS

E. C. Newman, of the Newman Mfg. Co., Cincinnati, Ohio, was married to Miss Henrietta Cohen, of New York City, July 2.

Charles F. Scribner has taken a position as efficiency engineer on the staff of the New England Westinghouse Co. at Springfield, Mass.

J. A. Eden, Jr., is no longer connected with the Baush Machine Tool Co., Springfield, Mass., having resigned the position of general manager June 24. Mr. Eden has no plans for the future.

Henry M. Sonnenthal and Frederick M. Sonnenthal, two of the directors of the Selson Engineering Co., Ltd., with offices at 78 Broad St., New York City, have changed their surnames to Selson, and will in future take the names of Henry M. Selson and Frederick M. Selson.

Walter J. Newman, manager of the Chicago plant of the Newman Mfg. Co., Cincinnati, Ohio, manufacturer of lathe tool attachments, architectural and ornamental brass, bronze and wrought steel work, was married to Miss Ella Hochbaum, of Chicago, June 11, at the Hotel LaSalle.

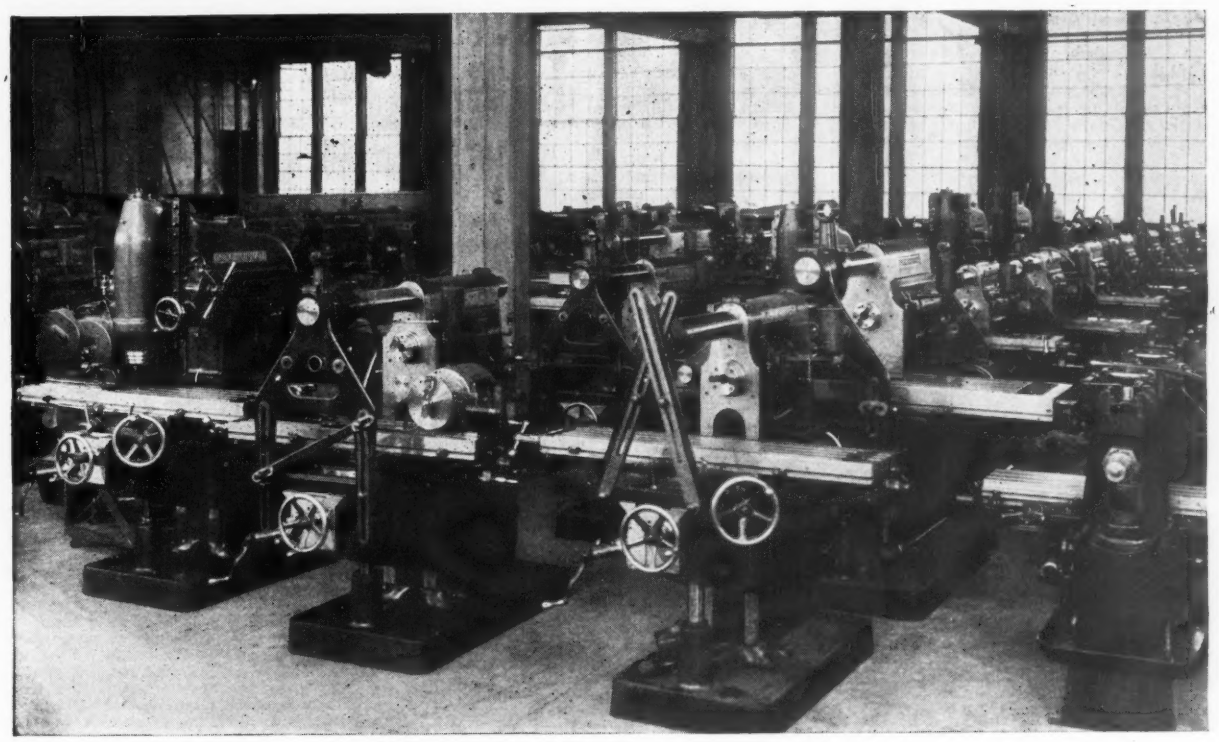
John Calder has been appointed assistant to H. H. Pinney, vice-president of the Remington Arms-Union Metallic Cartridge Co., and will represent Mr. Pinney as chief executive at the Remington plant in Bridgeport. Mr. Calder was general manager of the Remington Typewriter Co. in Ilion for several years.

John W. Horne has resigned as secretary and treasurer of the Horne-Dale-Brown Co., Chicago, and has sold his interest in the company. Mr. Horne has arranged to represent some tool and machinery manufacturers not already represented in Chicago territory. During the last eighteen years, he was Chicago manager for the Norton Co., Worcester, Mass., and manager of the machinists' supply department for H. Channon Co. and Samuel Harris & Co.

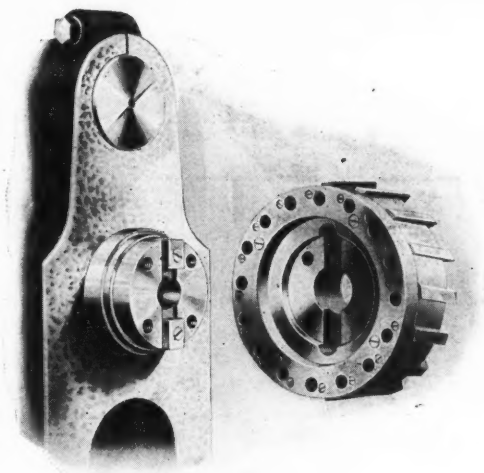
OBITUARIES

George Gilmour, chief engineer of the Travelers' Insurance Co., died June 15, aged fifty-one years. Mr. Gilmour was a trustee of the American Museum of Safety. He had given much attention to accident prevention methods and was recognized as one of the authorities in safety engineering.

William A. Warman, mechanical superintendent and designer of the Keller Mechanical Engraving Co., Brooklyn, N. Y., died July 2 of tuberculosis, aged fifty-five years. Mr. Warman was a mechanic of unusual ability, being inventive and resourceful. He had developed a number of inventions and was interested in more that had not been brought to a practical conclusion.



Complete Interchangeability of Face Mills



An Important Cincinnati Miller Improvement

We designed these flanged spindle ends, with hardened keys, for our large size High Power Millers and then adopted them for all Cincinnati Millers of High Power Design, Plain, Universal and Vertical, also Cincinnati Automatic Millers. These spindle ends are all of the same size. Hence any one face mill will fit all of the 22 different sizes of Cincinnati Milling Machines shown above.

Now for further advantages:

Understand, first, the cutter is slightly counterbored to fit closely over the spindle end for centering it and is held in place by bolts.

The drive is entirely through the hardened keys which are fitted to and form part of the spindle end.

The drive is powerful, durable and positive. And the face mills are easily put on and, even after heavy service, easily taken off.

Cutter arbors for these machines have a similar flange with a corresponding keyway. They are driven direct by the same keys in the flanged spindle end that are used for driving face mills. There is no intermediate driving collar.

The Bulletin which describes this latest improvement is just off the press. Where shall we address your copy?

The Cincinnati Milling Machine Company

Cincinnati Ohio

COMING EVENTS

August 15.—Annual meeting of the International Railroad Master Blacksmiths Association, Chicago, Ill. A. L. Woodworth, secretary and treasurer, C. H. & D. Ry., Lima, Ohio.

August 31.—Monthly meeting of the Rochester Society of Technical Draftsmen, in Rooms 131-137, Sibley Block, 328 Main St., E., Rochester, N. Y. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester.

September 5-8.—Annual convention of the Traveling Engineers' Association at Chicago, Ill. W. O. Thompson, secretary, New York Central Car Shops, E. Buffalo, N. Y.

September 11-16.—Annual convention of the American Foundrymen's Association and the American Institute of Metals, Cleveland, Ohio, in the Cleveland Coliseum. A. O. Backert, secretary-treasurer, American Foundrymen's Association, Cleveland, Ohio.

September 11-16.—Exhibition of machines, equipments and supplies for the foundry and allied industries in conjunction with the annual conventions of the American Foundrymen's Association and American Institute of Metals, at Cleveland, Ohio, in the Coliseum. C. E. Hoyt, manager, 1949 W. Madison St., Chicago, Ill.

September 25-30.—Second National Exposition of Chemical Industries, Grand Central Palace, New York City.

September 28-30.—Meeting of the American Electrochemical Society at Grand Central Palace, New York City. Secretary, J. Malcolm Muir, 239 W. 39th St., New York City.

SOCIETIES, SCHOOLS AND COLLEGES

New Mexico State School of Mines, Socorro, N. M. Annual register for 1915-1916 with announcements for 1916-1917.

University of South Carolina, Columbia, S. C. Catalogue 1915-1916 with calendars for 1915-1916 and 1916-1917.

Providence Engineering Society, Providence, R. I., will occupy its new rooms at 29 Waterman St. when it opens for its fall and winter work next September. The whole second floor of the building has been taken over and will be remodeled and equipped in a modern and attractive manner. The society expects to pursue an interesting and useful line of work for the coming year.

NEW BOOKS AND PAMPHLETS

Strength and Other Properties of Concrete as Affected by Materials and Methods of Preparation. By R. J. Wig, G. M. Williams and E. R. Gates. 172 pages, 7 by 10 inches. Illustrated. Published by the Department of Commerce, Washington, D C., as Technologic Paper of the Bureau of Standards No. 58.

The Winnipeg River Power and Storage Investigations. By J. T. Johnson, Chief Hydraulic Engineer. In two volumes: Volume I, 511 pages, 6⅝ by 9¾ inches. Illustrated. Volume II, Charts, 6 by 9¾ inches. Published by the Department of the Interior, Ottawa, Canada.

The growing realization of the importance of water powers makes this voluminous report of much interest and value to mechanical and civil engineers generally. It is claimed that the power available from the Winnipeg River is greater than that now being developed at Niagara Falls. Long-distance electrical transmission will make the power available over a wide area, and the ultimate development will profoundly affect the industrial life of Ontario.

Predetermination of Prices. By Frederick Parkhurst. 96 pages, 6 by 9¼ inches. Illustrated. Published by John Wiley & Sons, Inc., 432 Fourth Ave., New York City. Price, $1.25.

The purpose of this book is to present an argument in favor of the possibility of predetermining true costs. To substantiate this argument, the author has entered into a brief consideration of important factors which govern the making of such a determination. The text is divided into eight chapters which cover the following subjects: Importance of Absolute Control of all Sources of Information; Discussion of the Elements Affecting True Costs; Direct Costs; Indirect Costs; Recapitulation of Costs; Estimating; Profit and Relatively True Selling Prices; Conclusions.

Ammunition Manufacture—Processes and Hazards of Artillery and Small Arms Ammunition Manufacture. By W. D. Milne. 28 pages, 6 by 9 inches. Paper covered. Published by the Underwriters' Bureau of New England, 141 Milk St., Boston, Mass.

This report deals with the hazards of munitions manufacture from the standpoint of the insurance companies. It treats of the manufacture of shrapnel, projectile cases, shrapnel shell filling, shrapnel fuse, loading fuse powder trains, artillery cartridge cases, artillery primers, fulminates and primer loading, storage, blending and drying of black powder, small arms ammunition, distribution of manufacture, bullets, cartridge cases, primers, loading cartridge clips, powder houses and hazards of powder and fulminates.

Questions and Answers on Automobile Design, Construction and Repair. By Victor W. Page. 701 pages, 5 by 7½ inches. 387 illustrations. Published by the Norman W. Henley Publishing Co., New York City. Price, $1.50.

This treatise consists of a series of thirty-seven lessons covering over two thousand questions and answers on the motor car, its construction, operation and repair. The modern gasoline car and its principal parts are described in the first lesson, and then follows a description of the action of two- and four-stroke cycle motors, the parts of gasoline motors and their functions, fuels for automobile motors, theory of carburetion and its application, etc. The work is one that should appeal to those who like the catechism style of presenting technical information.

Strength of Webs of I-Beams and Girders. By Herbert F. Moore and W. M. Wilson. 50 pages, 6 by 9 inches. 22 illustrations. Published by the Engineering Experiment Station of the University of Illinois, Urbana, Ill. Price, 30 cents.

The bulletin records the results of tests made at the Engineering Experiment Station of the University of Illinois on a number of specimens consisting of 12-inch I-beams having the webs planed down to a thin section and 24-inch built-up girders having webs of thin plates. The results of the tests show that in general the shearing stress is a maximum at the neutral axis, but that diagonal stress at the junction of web and flange must be considered. Tests show that stiffeners at supports and under concentrated loads are very necessary. A formula is given for determining the buckling strength of webs.

Safety First for Vocational Schools. Prepared by Lewis A. Wilson. 90 pages, 5¾ by 9 inches. Illustrated. Published by the University of the State of New York, Albany, N. Y.

The bulletin treats on vocational school accidents and their legal aspect; safety precautions for school boards; safety suggestions for vocational teachers; general safety rules for pupils; how to organize a safety campaign in a vocational school; fire drills, instructions and precautions; general safeguarding rules; rules for guarding and operating woodworking machines; rules for guarding and operating machine shop equipment; safeguarding the electrical shop; resuscitation from shock; safety precautions for plumbers, printers, painters, decorators, pattern-makers, blacksmiths, etc. The bulletin, although intended primarily for vocational schools, will be found generally serviceable for instructing all classes of workers in industrial establishments.

The Marine Steam Turbine. By J. W. M. Sothern. 561 pages, 6 by 9 inches. Illustrated. Published in America by D. Van Nostrand Co., New York City. Price, $6.

This book is of the fourth edition, revised to include a number of improvements that have developed in marine steam turbine design, especially the introduction of gearing between the propeller driving shaft and the turbine to obtain the maximum efficiency of both turbine and propeller. The contents by chapter heads are as follows: Definitions and General Principles; Workshop Practice; Data from Actual Practice; Torsion Meters; General Notes; Temperature-Entropy Diagrams; General Turbine Data; Impulse Turbines and Combined Impulse and Reaction Turbines; Description of the Curtis Turbine; Geared-down Turbines; Practical Operation of Turbine Machinery; Data from Actual Practice; Shaft Horsepower; Condensers and Auxiliaries; Oil Fuel; and Boilers. The work is illustrated by over 330 diagrams, photographs and detail drawings. The book is suitable for naval and mercantile marine engineers, students and others concerned with the theory of marine steam turbines and their practical application for the propelling of vessels. The author is the principal of Sothern's Marine Engineering College, Glasgow, Scotland. Previous editions have been translated into French, German, Spanish and Dutch, and the work, therefore, has an international reputation.

The Engineer in War. By P. S. Bond. 187 pages, 5 by 7⅜ inches. Illustrated. Published by the McGraw-Hill Book Co., Inc., 239 W. 39th St., New York City. Price, $1.50.

Military field engineering is a practical art and cannot be acquired by study alone; but engineering plays such an important part in all operations of warfare that there is little exaggeration in stating modern warfare to be an application of engineering science to the armed conflicts of states. Those who have considered the military policy of the United States cannot have failed to observe how greatly it depends upon the voluntary service of citizens; in fact, the rights and privileges of citizenship carry with them an obligation of service to the state, but mere tacit recognition of a duty does not insure its efficient discharge. Acknowledgment of a duty involves the necessity of preparing for its performance, and if we do not prepare, we are evading the duty. In such voluntary preparation of citizens to fulfill their obligations to the state, civil engineers play an important part, as it is obviously impossible to train non-professional men to give satisfactory service in military engineering. It is to meet the requirements of such men that the present text has been prepared. The author does not aim to provide a treatise of military field engineering, as he recognizes the existence of a number of excellent manuals and text-books on this subject. The aim has been to present a brief outline of the relation of engineering practice to the conduct of modern warfare, and the adaptation of principles and practices of civil engineering to military requirements.

Power Transmission by Leather Belting. By Robert Thurston Kent. 114 pages, 5½ by 8¼ inches. Illustrated. Published by John Wiley & Sons, Inc., 432 Fourth Ave., New York City. Price, $1.25.

The development of high-speed steel cutting tools and the intensive methods of manufacture which have resulted from their use have placed greater demands upon the drives used for machine tools. Necessary improvements in power transmission systems have been developed, but the change has come so gradually and unobtrusively that many engineers have not realized the improvements that have been made in this branch of engineering practice, and literature of power transmission—especially the transmission of power by belting—has not been kept up to date. Many excellent papers have been read before various engineering societies, and contributions of equal merit have appeared in the technical press, and in his introduction to the present text the author makes acknowledgment to these sources for much of the information that he has presented. The subject is covered in a comprehensive manner, with equal stress laid upon theory and practice. Theoretical discussions and explanation of practical matters are separated, and as a result the shop engineer, master mechanic or man in charge of belts in the shop can readily obtain the necessary information in regard to the selection of the proper size of belt to transmit a given horsepower, the tension at which it should be operated and the length of time which ought to elapse between retightening, together with notes on the proper care and maintenance of belts. In like manner, the engineer will find the subject treated from the standpoint of theory as well as practice, so that his requirements are well taken care of.

Economics of World Trade. By O. P. Austin. 141 pages, 5 by 7½ inches. Illustrated. Published by the Business Training Corporation, 185 Madison Ave., New York City.

This is the first of a series of texts for a course in foreign trade issued under the direction of Dr. Edward Ewing Pratt, Chief of the Bureau of Foreign and Domestic Commerce of the United States Department of Commerce. This first volume contains an "Introduction to the Course in Foreign Trade," written by Dr. Pratt, which discusses the various factors that make foreign trade a dominant factor in American commercial prosperity. Dr. Pratt traces the development of the United States from the time when we were a commercially provincial nation down to the present, when we have assumed the export leadership of the world. The significant increase in the proportion of our manufactured to our raw materials and foodstuffs exports is graphically brought out. During the decade ending with 1889 the proportion was 80 per cent of crude materials and foodstuffs to about 20 per cent of manufactured goods exported. In the period 1890 to 1899 the proportion was 75 per cent of crude materials and foodstuffs to about 25 per cent of manufactures. In the period ending 1909 the proportions were 62 per cent of foodstuffs and raw materials and 38 per cent for manufactures. During the period 1910 to 1914 the proportion of manufactures rose to 47 per cent, as against 53 per cent for foodstuffs and crude materials. Not only has our trade with the European countries increased tremendously since the war, but it has also increased elsewhere, for example: South America, 20 per cent; Africa, 40 per cent; Asia, 40 per cent; Australia, 40 per cent. "Will we and can we retain this increased trade?" is a question that Dr. Pratt both asks and answers. The level of costs after the war, the factors of commercial good will, capital requirements and supply, and labor conditions in Europe after the war, as they bear on our future export trade, are discussed. Following the introduction is the first text, which is written by O. P. Austin, statistician of the National City Bank and formerly chief of the Bureau of Manufactures of the United States government. This part of the volume sets forth the underlying factors which control the world currents of foreign trade. Such subjects as the export of surplus production, the export of capital, the control of transportation, colonization and emigration, trade routes and trade centers, the seasonal movement of commodities, artificial stimuli to trade, protection and free trade, are all discussed thoroughly and interestingly. It is perhaps safe to say that this subject of world trade economics is nowhere else treated with equal clearness and authority.

NEW CATALOGUES AND CIRCULARS

Roller-Smith Co., 233 Broadway, New York City. Bulletin 300 descriptive of portable direct-reading slide wire ohmmeters.

Richards-Wilcox Mfg. Co., Aurora, Ill. Catalogue of overhead trolley and I-beam carrying equipment for loads up to four tons.

Reed Small Tool Works, Worcester, Mass. Leaflet describing the Reed caliper and giving prices for sizes from 1 to 6 inches.

Persons-Arter Machine Co., Worcester, Mass. Catalogue 2 illustrating and describing Model A 8- to 12-inch rotary surface grinders equipped with magnetic chucks.

United States Lathe & Machine Co., Cincinnati, Ohio. Circular of the United States 20-inch, heavy-duty, screw cutting engine lathe with quick-change, five-step cone and single back-gear.

Vulcan Soot Cleaner Co., Dubois, Pa. Catalogue on Vulcan soot cleaners as applied to boilers, superheaters, economizers, garbage destructor boilers, waste heat boilers and similar apparatus.

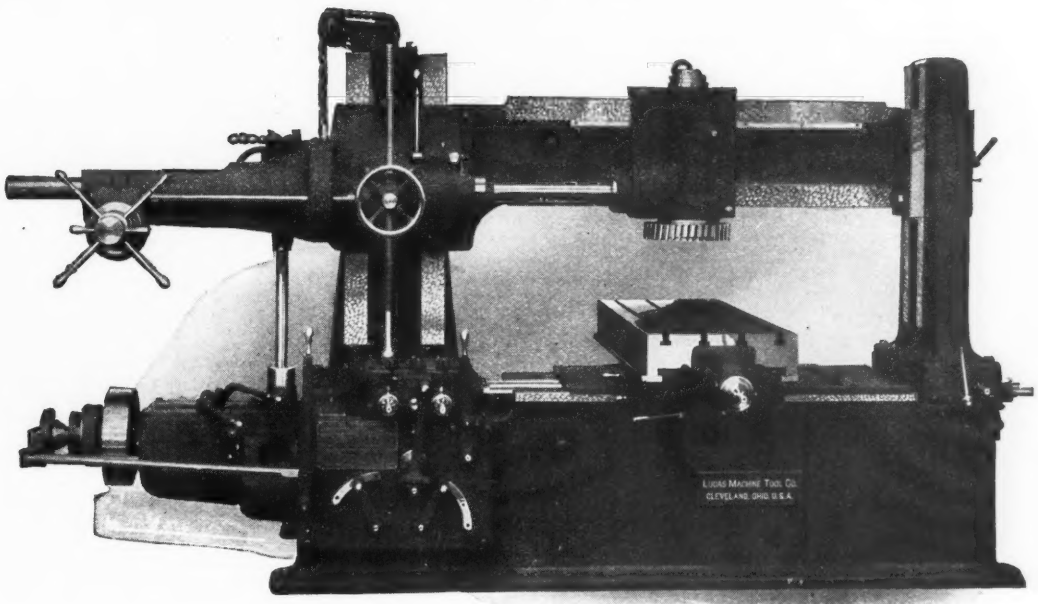
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. Bulletin 1004 showing panoramic view of the new laboratories of the Massachusetts Institute of Technology which are served by Shepard electric cranes.

Electric Controller & Mfg. Co., Cleveland, Ohio. Price lists for E. C. & M. ventilated controllers, brakes, push buttons, motor starters, rheostats, switches, pressure regulators, safety limit stops and crane switchboards.

Keuffel & Esser Co., Hoboken, N. J. Circular of a new flexible curve rule in 12-, 18-, 24- and 30-inch lengths. It is claimed that the rule embodies all the advantages with none of the drawbacks of the ordinary curve rulers.

DO you make DIES or MOLDS that are TOO LARGE for a regular DIE SINKING MACHINE and have to be made in sections and built up, thus increasing the cost, and decreasing the strength and life of the die? If so, the

LUCAS "PRECISION" Boring, Drilling and Milling Machine



WITH VERTICAL MILLING ATTACHMENT

IS IT

LUCAS MACHINE TOOL CO., NOW AND ALWAYS OF CLEVELAND, O., U.S.A.

S. K. F. Ball Bearing Co., Hartford, Conn. Bulletin entitled "S.K.F. Ball Bearings for Cotton Seed Oil Machinery," describing the construction of S.K.F. ball bearings and the advantages gained by their use in this class of machinery.

Chicago Pneumatic Tool Co., Fisher Bldg., Chicago, Ill. Bulletin E-41, superseding E-32, illustrating "Duntley" electric track drills, heavy-duty side-spindle and center-spindle drills, electric grinders, spike drivers, etc.

National Machinery Co., Tiffin, Ohio. National Forging Machine Talk No. 13 discusses the advantage of large gathering capacity in a forging machine and shows how this applies to the National heavy-pattern forging machine.

Chicago Flexible Shaft Co., 149 W. LaSalle St., Chicago, Ill. Catalogue of flexible shafts and tools for grinding, reaming, polishing, drilling, tapping, buffing, boring, sanding, etc. These flexible shafts are of the wire and link core types.

Alexander Milburn Co., 1420 W. Baltimore St., Baltimore, Md. Folder illustrating Milburn oxy-acetylene welding and cutting apparatus, including welding torch, pressure regulators, cutting torch, generators, portable welding outfits, etc.

National Scale Co., 6 Mechanic St., Chicopee Falls, Mass. Circular illustrating "Multi-unit" sectional steel shelving which permits of arrangement in sections by the multiplication of any number of units, which interlock. Units can be added as required.

Day & Zimmermann, 611 Chestnut St., Philadelphia, Pa., has begun the publication of a house organ called "Development," the object of which is "to disperse ideas, advice and information for use in the proper development of industries and public utilities."

Diamond Machine Co., Providence, R. I. Catalogue showing the line of Diamond wet tool grinding machines, which contains sixteen different sizes and types. Specifications are given for wet tool grinding machines of the floor and bench types, belt- and motor-driven.

U. S. Ball Bearing Mfg. Co., Chicago, Ill. Catalogue F describing U. S. ball bearings. The booklet contains information on the hardening and grinding of these bearings and illustrates the standard types of radial bearings, adapter bearings, cone type bearings and thrust bearings.

Montgomery & Co., 104 Fulton St., New York City. Price sheet entitled "Odds and Ends," giving sizes and prices of arbors, bolts, hacksaw blades, blocks, broaches, chucks, cutters, dressers, drills, extinguishers, files, holders, screws, screwdrivers, taps, tapes, carpenters' and woodworkers' tools, and other tools, supplies and machinery made by this company.

Nordberg Mfg. Co., Milwaukee, Wis. Bulletin 28, covering the Nordberg line of poppet valve engines, which includes three types, namely, full poppet, poppet-uniflow and poppet Corliss. The engine best suited for the purpose is recommended in each case. In addition to describing the construction of the different types of engines the book gives results of tests made on these engines.

Draeger Oxygen Apparatus Co., 422 First Ave., Pittsburg, Pa. Folder descriptive of type B pulmotor, a hand-operated resuscitation device, insuring a safe and efficient pressure. This type of pulmotor is equipped with a regulating valve by means of which air is allowed to escape to any degree desired, reducing the inhalation pressure as shown by the indicator gage.

Hub Machine, Welding & Contracting Co., 22nd and Race Sts., Philadelphia, Pa. Circulars illustrating "Acme" metal saw table in two sizes. Table No. 1 is 18 by 18 inches and takes saws up to 6 inches diameter; table No. 2 is 22 by 24 inches and takes saws up to 10 inches diameter. These machines are being used extensively at present for cutting copper cartridges. They are also specially designed for cutting copper shells and tubing, brass tubing, sheet and rod metal, fiber, rubber, etc.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Circular illustrating Westinghouse reversing motor equipments applied to metal planers. These direct-connected reversing motors have 4 to 1 speed adjustment by field control, and the controller gives fine speed increments. The circular points out the advantages resulting from the use of reversing motors on planers and other machines having reciprocating motion.

Phoenix Mfg. Co., Eau Claire, Wis. Catalogue of Conradson geared-head engine lathes, geared-head projectile lathes and geared-head special lathes, built in 21 inches and 28 inches swing. The spindle drive is effected by means of duplex gears and worm-gears of widely varying ratios. The general construction has been worked out to afford the maximum of rigidity and power so that the heaviest cuts may be taken without excessive vibration.

David McLain, Goldsmith Bldg., Milwaukee, Wis. Booklet on McLain's semi-steel, showing semi-steel castings in wide variety and illustrating the superior physical characteristics of semi-steel consisting of 30 to 50 per cent steel which is claimed to have a tensile strength of 34,000 to 38,000 pounds. Booklet containing synopsis of McLain's System which comprises information and instructions in a set of twelve printed lessons covering gray iron mixtures, cupola practice and the making of semi-steel.

J. T. Slocomb Co., Providence, R. I. Catalogue 15 covering complete line of Slocomb micrometer calipers and center drills. The latter half of this catalogue is called, "The Measuring Book," and contains suggestions in regard to accurate and economical measuring in machine construction by the use of micrometer calipers. This section of the book is illustrated with halftone and line engravings, making the matter very clear, and contains much useful material including tables of decimal equivalents, tap drill sizes, speeds for twist drills, diameters of centers, sizes of center drills and speeds, etc.

Sweet's Catalogue Service, Inc., 115-119 W. 40th St., New York City. Second annual edition of Sweet's engineering catalogue which contains a collection of condensed catalogues, comprising materials of construction, contractors' plant, power plant equipment and allied products, completely indexed with cross references. The catalogues cover 823 pages, 8½ by 12 inches. The index is divided into three parts, the first part containing the manufacturers' names, the second part, classified list of products and the third part, trade names. The catalogue also contains a specification digest for aid in specification writing. This is intended for use in connection with the power plant section and occupies 80 pages.

American Pulley Co., 4208-60 Wissahickon Ave., Philadelphia, Pa. Booklet entitled, "Belt Pulleys," by Charles A. Brinley, a reprint of a paper read before the Engineers Club of Philadelphia, June 20, 1916. This booklet contains valuable pulley information including data of the results of tests on pulleys made at the American Pulley Co.'s plant, under the supervision of William W. Crosby. The company has also issued another booklet entitled, "Belt Pulleys—Report of Tests for Belt Slip," by H. M. Haven and William W. Crosby. The object of the tests was to determine the slip in feet between a belt and the face of a pulley when the belt was transmitting different known horsepowers to the pulley. The apparatus used is illustrated and the results of the tests are tabulated. These booklets will be sent free on request to those interested.

TRADE NOTES

Abbott Ball Co., Hartford, Conn., has let the contract for an addition to its ball bearing plant, two new buildings now being under way.

Hoskins Mfg. Co., 459 Lawton Ave., Detroit, Mich., has changed its Boston office from 185 Devonshire St. to 445 Tremont Bldg., 73 Tremont St.

Wagner Electric Mfg. Co., St. Louis, Mo., has moved its Detroit office to 1291 Woodward Ave. The office will continue to be in charge of Dean Emerson.

Newman-Andrew Co., American representative of Jno. Hy. Andrew & Co., Ltd., Toledo Steel Works, Sheffield, England, has moved from 107 West St. to larger offices at 26 Cortlandt St., New York City.

Ready Tool Co., 654 Main St., Bridgeport, Conn., has purchased a plot on the corner of Railroad Ave. and Iranistan St., Bridgeport, and has placed a contract for the erection of a brick factory building, to begin at once.

Brown & Sharpe Mfg. Co., Providence, R. I., will close from July 28 to August 8 for the annual vacation. During this time the offices will be open as usual, and orders for machine tools, machinists' tools and cutters will receive the same attention as at any other period of the year.

W. H. Nicholson & Co., 112 Oregon St., Wilkesbarre, Pa., secured an order for 1017 Nicholson compression shaft couplings for 2 7/16-inch shafting from the Remington Arms & Ammunition Co. for the ordnance plant at Ilion, N. Y. The Nicholson couplings are of the four-jaw compression type which is applied without milling keyways in the shafting.

National Twist Drill & Tool Co., Detroit, Mich., is erecting a three-story concrete and brick office building, 42 by 81 feet. A four-story factory addition, 45 by 76 feet, with L-connection to the office building 45 by 73 feet, is also being erected and is nearly completed. The dimensions given in the July number were incorrect in regard to the factory addition and L-connection.

Glidden Varnish Co., Cleveland, Ohio, has built a large addition of concrete, fireproof construction throughout, affording 27,000 square feet of additional floor space. The addition will be equipped throughout with modern machinery for the manufacture of paints and varnishes. The plant occupies an area of 16½ acres, and the total floor space of the buildings is 190,000 square feet. Complete lines of varnishes and paint specialties are manufactured for the requirements of all industries.

G. Hartmann has opened an office in the Tribune Bldg., New York City, where he will act as representative of the following machine firms in Norway, Finland, Sweden and Russia: G. Hartmann, Ltd., Christiania; Finska G. Hartmanns Maskinaffar, Ltd., Helsingfors; G. Hartmanns Maskinaffar, Ltd., Stockholm; and Christian Christiansen, Petrograd and Moscow. He will act as agent for the purchase of metal working machinery, machine tools, metals, tubing, crucibles and other materials required in general manufacture.

Russo-Baltic Car Works Co., Room 242, Metropolitan Tower, 1 Madison Ave., New York City. The company, which was incorporated in Petrograd, Russia, has sent a commission to America for the purpose of purchasing materials and machines for the company's new automobile plant in Russia, and not for the purpose of purchasing materials for the manufacture of railway cars and other railway equipment. The commission invites all concerns offering machinery, etc., for the manufacture of motor cars to send catalogues and printed matter descriptive of their products.

Diamond Chain & Mfg. Co., 240 W. Georgia St., Indianapolis, Ind., has begun the erection of a complete manufacturing plant on a six-acre tract of land located on Kentucky Ave. The new structure will be of concrete, four stories high, with 150,000 square feet floor space. The main building will be 380 by 60 feet with two L's 100 feet long, making the entire frontage 700 feet. A power plant and auxiliary buildings will be located in the L's. It is expected that the buildings and new equipment will double the present capacity of the plant. Plans, specifications, engineering and construction are in charge of Westinghouse, Church, Kerr & Co.

Cincinnati Milling Machine Co., Cincinnati, Ohio, gave a birthday party to its employes at the Cincinnati Zoological Garden, July 1, in honor of the fiftieth birthday of the president, Frederick A. Geier. About 4200 employes and members of their families accepted the invitation and participated in the events. The program included a shoe race, potato race, three-legged race, sack race, tug of war, ladies' and gentlemen's race, track race around the lake, fifty-yard dash, peanut race for girls, pipe-lighting race for girls and men, flag race, nail-driving contest for women, rolling hoop around the lake (fat men only eligible), donkey driving contest, goat riding pillow contest. The party was voted a great success by all participating.

International Oxygen Co., 115 Broadway, New York City, is installing a new plant at College Point, L. I., for the manufacture of oxygen and hydrogen gas. It is expected that the installation will be completed late in August or early in September. When completed the company's trade in Brooklyn and environs, as well as in Manhattan, will be largely handled from the College Point plant. Heretofore this local business has been supplied by the company's Newark works. About six years ago the company acquired the American rights to manufacture electrolytic gas generating apparatus. An oxygen-hydrogen generating plant was installed to demonstrate the efficiency of the apparatus and the purity of the gases, but the manufacture of apparatus is the main business of the company, this part of its business being concentrated at the Newark factory. The manufacture and distribution of gas in cylinders is a local and secondary matter.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has been awarded the contract for furnishing the necessary equipment for the electric propulsion of the U. S. S. "Tennessee," the superdreadnaught of the largest class, now under construction. The system of propulsion being installed differs from any now in use by battleships. Instead of the propellers being mechanically connected to the driving engines or turbines, there are two steam turbines developing over 33,000 horsepower driving electric generators which furnish current to four 6700-horsepower motors, each motor driving a propeller. Electric drive for battleships has been adopted after a careful investigation by the Navy Department to whom it presented numerous features of structural, operating, and military advantages, among which are that the steam turbines developing the electric energy may be located in any desired portion of the ship, that the propelling machinery may thus be better protected from injury, that full power may be available for reversing, and that greater rapidity in maneuvering is made possible compared with existing mechanical systems of control.

Morse Chain Co., Ithaca, N. Y., has lately increased its capital stock from $400,000 to $1,500,000 for the purpose of increasing the manufacturing facilities. New buildings will be erected and additions made to old ones. The growth of the company has been remarkably rapid; it started with a fair-sized factory at Trumansburg, N. Y., in 1904, just about the time when electric motors came into general commercial use. In 1906 the business was moved to Ithaca, N. Y., to a new factory built especially for the purpose, and twice as large as the former one. In 1912 it was necessary to again enlarge, and the floor space was more than doubled by additions. The present plans contemplate again doubling the size of the plant. A large storage building has been about completed and additions to the steel and wire mills and a new gas producer building are well under way. Another addition to the main building, increasing its total length to more than 900 feet, will soon be started. When the buildings are completed the company will have a total floor space of approximately seven acres, which will be devoted exclusively to the manufacture of the Morse rocker-joint power transmission chain.

CLASSIFIED AND WANT ADVERTISEMENTS

Will be found on page 269 of this issue and will be run in the same relative position in future.

COMING EVENTS

August 15.—Annual meeting of the International Railroad Master Blacksmiths Association, Chicago, Ill. A. L. Woodworth, secretary and treasurer, C. H. & D. Ry., Lima, Ohio.

August 31.—Monthly meeting of the Rochester Society of Technical Draftsmen, in Rooms 131-137, Sibley Block, 328 Main St., E., Rochester, N. Y. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester.

September 5-8.—Annual convention of the Traveling Engineers' Association at Chicago, Ill. W. O. Thompson, secretary, New York Central Car Shops, E. Buffalo, N. Y.

September 11-16.—Annual convention of the American Foundrymen's Association and the American Institute of Metals, Cleveland, Ohio, in the Cleveland Coliseum. A. O. Backert, secretary-treasurer, American Foundrymen's Association, Cleveland, Ohio.

September 11-16.—Exhibition of machines, equipments and supplies for the foundry and allied industries in conjunction with the annual conventions of the American Foundrymen's Association and American Institute of Metals, at Cleveland, Ohio, in the Coliseum. C. E. Hoyt, manager, 1949 W. Madison St., Chicago, Ill.

September 25-30.—Second National Exposition of Chemical Industries, Grand Central Palace, New York City.

September 28-30.—Meeting of the American Electrochemical Society at Grand Central Palace, New York City. Secretary, J. Malcolm Muir, 239 W. 39th St., New York City.

SOCIETIES, SCHOOLS AND COLLEGES

New Mexico State School of Mines, Socorro, N. M. Annual register for 1915-1916 with announcements for 1916-1917.

University of South Carolina, Columbia, S. C. Catalogue 1915-1916 with calendars for 1915-1916 and 1916-1917.

Providence Engineering Society, Providence, R. I., will occupy its new rooms at 29 Waterman St. when it opens for its fall and winter work next September. The whole second floor of the building has been taken over and will be remodeled and equipped in a modern and attractive manner. The society expects to pursue an interesting and useful line of work for the coming year.

NEW BOOKS AND PAMPHLETS

Strength and Other Properties of Concrete as Affected by Materials and Methods of Preparation. By R. J. Wig, G. M. Williams and E. R. Gates. 172 pages, 7 by 10 inches. Illustrated. Published by the Department of Commerce, Washington, D C., as Technologic Paper of the Bureau of Standards No. 58.

The Winnipeg River Power and Storage Investigations. By J. T. Johnson, Chief Hydraulic Engineer. In two volumes: Volume I, 511 pages, 6⅝ by 9¾ inches. Illustrated. Volume II, Charts, 6 by 9¾ inches. Published by the Department of the Interior, Ottawa, Canada.

The growing realization of the importance of water powers makes this voluminous report of much interest and value to mechanical and civil engineers generally. It is claimed that the power available from the Winnipeg River is greater than that now being developed at Niagara Falls. Long-distance electrical transmission will make the power available over a wide area, and the ultimate development will profoundly affect the industrial life of Ontario.

Predetermination of Prices. By Frederick Parkhurst. 96 pages, 6 by 9¼ inches. Illustrated. Published by John Wiley & Sons, Inc., 432 Fourth Ave., New York City. Price, $1.25.

The purpose of this book is to present an argument in favor of the possibility of predetermining true costs. To substantiate this argument, the author has entered into a brief consideration of important factors which govern the making of such a determination. The text is divided into eight chapters which cover the following subjects: Importance of Absolute Control of all Sources of Information; Discussion of the Elements Affecting True Costs; Direct Costs; Indirect Costs; Recapitulation of Costs; Estimating; Profit and Relatively True Selling Prices; Conclusions.

Ammunition Manufacture—Processes and Hazards of Artillery and Small Arms Ammunition Manufacture. By W. D. Milne. 28 pages, 6 by 9 inches. Paper covered. Published by the Underwriters' Bureau of New England, 141 Milk St., Boston, Mass.

This report deals with the hazards of munitions manufacture from the standpoint of the insurance companies. It treats of the manufacture of shrapnel, projectile cases, shrapnel shell filling, shrapnel fuse, loading fuse powder trains, artillery cartridge cases, artillery primers, fulminates and primer loading, storage, blending and drying of black powder, small arms ammunition, distribution of manufacture, bullets, cartridge cases, primers, loading cartridge clips, powder houses and hazards of powder and fulminates.

Questions and Answers on Automobile Design, Construction and Repair. By Victor W. Page. 701 pages, 5 by 7½ inches. 387 illustrations. Published by the Norman W. Henley Publishing Co., New York City. Price, $1.50.

This treatise consists of a series of thirty-seven lessons covering over two thousand questions and answers on the motor car, its construction, operation and repair. The modern gasoline car and its principal parts are described in the first lesson, and then follows a description of the action of two- and four-stroke cycle motors, the parts of gasoline motors and their functions, fuels for automobile motors, theory of carburetion and its application, etc. The work is one that should appeal to those who like the catechism style of presenting technical information.

Strength of Webs of I-Beams and Girders. By Herbert F. Moore and W. M. Wilson. 50 pages, 6 by 9 inches. 22 illustrations. Published by the Engineering Experiment Station of the University of Illinois, Urbana, Ill. Price, 30 cents.

The bulletin records the results of tests made at the Engineering Experiment Station of the University of Illinois on a number of specimens consisting of 12-inch I-beams having the webs planed down to a thin section and 24-inch built-up girders having webs of thin plates. The results of the tests show that in general the shearing stress is a maximum at the neutral axis, but that diagonal stress at the junction of web and flange must be considered. Tests show that stiffeners at supports and under concentrated loads are very necessary. A formula is given for determining the buckling strength of webs.

Safety First for Vocational Schools. Prepared by Lewis A. Wilson. 90 pages, 5¾ by 9 inches. Illustrated. Published by the University of the State of New York, Albany, N. Y.

The bulletin treats on vocational school accidents and their legal aspect; safety precautions for school boards; safety suggestions for vocational teachers; general safety rules for pupils; how to organize a safety campaign in a vocational school; fire drills, instructions and precautions; general safeguarding rules; rules for guarding and operating woodworking machines; rules for guarding and operating machine shop equipment; safeguarding the electrical shop; resuscitation from shock; safety precautions for plumbers, printers, painters, decorators, patternmakers, blacksmiths, etc. The bulletin, although intended primarily for vocational schools, will be found generally serviceable for instructing all classes of workers in industrial establishments.

The Marine Steam Turbine. By J. W. M. Sothern. 561 pages, 6 by 9 inches. Illustrated. Published in America by D. Van Nostrand Co., New York City. Price, $6.

This book is of the fourth edition, revised to include a number of improvements that have developed in marine steam turbine design, especially the introduction of gearing between the propeller driving shaft and the turbine to obtain the maximum efficiency of both turbine and propeller. The contents by chapter heads are as follows: Definitions and General Principles; Workshop Practice; Data from Actual Practice; Torsion Meters; General Notes; Temperature-Entropy Diagrams; General Turbine Data; Impulse Turbines and Combined Impulse and Reaction Turbines; Description of the Curtis Turbine; Geared-down Turbines; Practical Operation of Turbine Machinery; Data from Actual Practice; Shaft Horsepower; Condensers and Auxiliaries; Oil Fuel; and Boilers. The work is illustrated by over 330 diagrams, photographs and detail drawings. The book is suitable for naval and mercantile marine engineers, students and others concerned with the theory of marine steam turbines and their practical application for the propelling of vessels. The author is the principal of Sothern's Marine Engineering College, Glasgow, Scotland. Previous editions have been translated into French, German, Spanish and Dutch, and the work, therefore, has an international reputation.

The Engineer in War. By P. S. Bond. 187 pages, 5 by 7⅜ inches. Illustrated. Published by the McGraw-Hill Book Co., Inc.. 239 W. 39th St., New York City. **Price, $1.50.**

Military field engineering is a practical art and cannot be acquired by study alone; but engineering plays such an important part in all operations of warfare that there is little exaggeration in stating modern warfare to be an application of engineering science to the armed conflicts of states. Those who have considered the military policy of the United States cannot have failed to observe how greatly it depends upon the voluntary service of citizens; in fact, the rights and privileges of citizenship carry with them an obligation of service to the state, but mere tacit recognition of a duty does not insure its efficient discharge. Acknowledgment of a duty involves the necessity of preparing for its performance, and if we do not prepare, we are evading the duty. In such voluntary preparation of citizens to fulfill their obligations to the state, civil engineers play an important part, as it is obviously impossible to train non-professional men to give satisfactory service in military engineering. It is to meet the requirements of such men that the present text has been prepared. The author does not aim to provide a treatise of military field engineering, as he recognizes the existence of a number of excellent manuals and text-books on this subject. The aim has been to present a brief outline of the relation of engineering practice to the conduct of modern warfare, and the adaptation of principles and practices of civil engineering to military requirements.

Power Transmission by Leather Belting. By Robert Thurston Kent. 114 pages, 5½ by 8¼ inches. Illustrated. Published by John Wiley & Sons, Inc., 432 Fourth Ave., New York City. Price, $1.25.

The development of high-speed steel cutting tools and the intensive methods of manufacture which have resulted from their use have placed greater demands upon the drives used for machine tools. Necessary improvements in power transmission systems have been developed, but the change has come so gradually and unobtrusively that many engineers have not realized the improvements that have been made in this branch of engineering practice, and literature of power transmission—especially the transmission of power by belting—has not been kept up to date. Many excellent papers have been read before various engineering societies, and contributions of equal merit have appeared in the technical press, and in his introduction to the present text the author makes acknowledgment to these sources for much of the information that he has presented. The subject is covered in a comprehensive manner, with equal stress laid upon theory and practice. Theoretical discussions and explanation of practical matters are separated, and as a result the shop engineer, master mechanic or man in charge of belts in the shop can readily obtain the necessary information in regard to the selection of the proper size of belt to transmit a given horsepower, the tension at which it should be operated and the length of time which ought to elapse between retightening, together with notes on the proper care and maintenance of belts. In like manner, the engineer will find the subject treated from the standpoint of theory as well as practice, so that his requirements are well taken care of.

Economics of World Trade. By O. P. Austin. 141 pages, 5 by 7½ inches. Illustrated. Published by the Business Training Corporation, 185 Madison Ave., New York City.

This is the first of a series of texts for a course in foreign trade issued under the direction of Dr. Edward Ewing Pratt, Chief of the Bureau of Foreign and Domestic Commerce of the United States Department of Commerce. This first volume contains an "Introduction to the Course in Foreign Trade," written by Dr. Pratt, which discusses the various factors that make foreign trade a dominant factor in American commercial prosperity. Dr. Pratt traces the development of the United States from the time when we were a commercially provincial nation down to the present, when we have assumed the export leadership of the world. The significant increase in the proportion of our manufactured to our raw materials and foodstuffs exports is graphically brought out. During the decade ending with 1889 the proportion was 80 per cent of crude materials and foodstuffs to about 20 per cent of manufactured goods exported. In the period 1890 to 1899 the proportion was 75 per cent of crude materials and foodstuffs to about 25 per cent of manufactures. In the period ending 1909 the proportions were 62 per cent of foodstuffs and raw materials and 38 per cent for manufactures. During the period 1910 to 1914 the proportion of manufactures rose to 47 per cent, as against 53 per cent for foodstuffs and crude materials. Not only has our trade with the European countries increased tremendously since the war, but it has also increased elsewhere, for example: South America, 20 per cent; Africa, 40 per cent; Asia, 40 per cent; Australia, 40 per cent. "Will we and can we retain this increased trade?" is a question that Dr. Pratt both asks and answers. The level of costs after the war, the factors of commercial good will, capital requirements and supply, and labor conditions in Europe after the war, as they bear on our future export trade, are discussed. Following the introduction is the first text, which is written by O. P. Austin, statistician of the National City Bank and formerly chief of the Bureau of Manufactures of the United States government. This part of the volume sets forth the underlying factors which control the world currents of foreign trade. Such subjects as the export of surplus production, the export of capital, the control of transportation, colonization and emigration, trade routes and trade centers, the seasonal movement of commodities, artificial stimuli to trade, protection and free trade, are all discussed thoroughly and interestingly. It is perhaps safe to say that this subject of world trade economics is nowhere else treated with equal clearness and authority.

NEW CATALOGUES AND CIRCULARS

Roller-Smith Co., 233 Broadway, New York City. Bulletin 300 descriptive of portable direct-reading slide wire ohmmeters.

Richards-Wilcox Mfg. Co., Aurora, Ill. Catalogue of overhead trolley and I-beam carrying equipment for loads up to four tons.

Reed Small Tool Works, Worcester, Mass. Leaflet describing the Reed caliper and giving prices for sizes from 1 to 6 inches.

Persons-Arter Machine Co., Worcester, Mass. Catalogue 2 illustrating and describing Model A 8- to 12-inch rotary surface grinders equipped with magnetic chucks.

United States Lathe & Machine Co., Cincinnati, Ohio. Circular of the United States 20-inch, heavy-duty, screw cutting engine lathe with quick-change, five-step cone and single back-gear.

Vulcan Soot Cleaner Co., Dubois, Pa. Catalogue on Vulcan soot cleaners as applied to boilers, superheaters, economizers, garbage destructor boilers, waste heat boilers and similar apparatus.

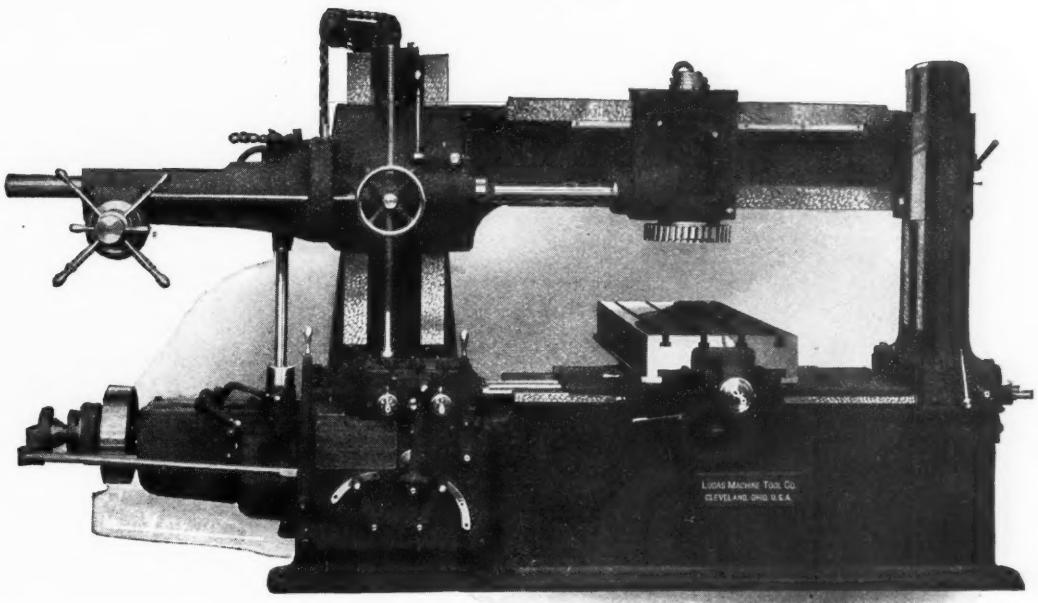
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. Bulletin 1004 showing panoramic view of the new laboratories of the Massachusetts Institute of Technology which are served by Shepard electric cranes.

Electric Controller & Mfg. Co., Cleveland, Ohio. Price lists for E. C. & M. ventilated controllers, brakes, push buttons, motor starters, rheostats, switches, pressure regulators, safety limit stops and crane switchboards.

Keuffel & Esser Co., Hoboken, N. J. Circular of a new flexible curve rule in 12-, 18-, 24- and 30-inch lengths. It is claimed that the rule embodies all the advantages with none of the drawbacks of the ordinary curve rulers.

DO you make DIES or MOLDS that are TOO LARGE for a regular DIE SINKING MACHINE and have to be made in sections and built up, thus increasing the cost, and decreasing the strength and life of the die? If so, the

LUCAS "PRECISION" Boring, Drilling and Milling Machine



WITH VERTICAL MILLING ATTACHMENT

IS IT

LUCAS MACHINE TOOL CO., NOW AND ALWAYS OF CLEVELAND, O., U.S.A.

S. K. F. Ball Bearing Co., Hartford, Conn. Bulletin entitled "S.K.F. Ball Bearings for Cotton Seed Oil Machinery," describing the construction of S.K.F. ball bearings and the advantages gained by their use in this class of machinery.

Chicago Pneumatic Tool Co., Fisher Bldg., Chicago, Ill. Bulletin E-41, superseding E-32, illustrating "Duntley" electric track drills, heavy-duty side-spindle and center-spindle drills, electric grinders, spike drivers, etc.

National Machinery Co., Tiffin, Ohio. National Forging Machine Talk No. 13 discusses the advantage of large gathering capacity in a forging machine and shows how this applies to the National heavy-pattern forging machine.

Chicago Flexible Shaft Co., 149 W. LaSalle St., Chicago, Ill. Catalogue of flexible shafts and tools for grinding, reaming, polishing, drilling, tapping, buffing, boring, sanding, etc. These flexible shafts are of the wire and link core types.

Alexander Milburn Co., 1420 W. Baltimore St., Baltimore, Md. Folder illustrating Milburn oxy-acetylene welding and cutting apparatus, including welding torch, pressure regulators, cutting torch, generators, portable welding outfits, etc.

National Scale Co., 6 Mechanic St., Chicopee Falls, Mass. Circular illustrating "Multi-unit" sectional steel shelving which permits of arrangement in sections by the multiplication of any number of units, which interlock. Units can be added as required.

Day & Zimmermann, 611 Chestnut St., Philadelphia, Pa., has begun the publication of a house organ called "Development," the object of which is "to disperse ideas, advice and information for use in the proper development of industries and public utilities."

Diamond Machine Co., Providence, R. I. Catalogue showing the line of Diamond wet tool grinding machines, which contains sixteen different sizes and types. Specifications are given for wet tool grinding machines of the floor and bench types, belt- and motor-driven.

U. S. Ball Bearing Mfg. Co., Chicago, Ill. Catalogue F describing U. S. ball bearings. The booklet contains information on the hardening and grinding of these bearings and illustrates the standard types of radial bearings, adapter bearings, cone type bearings and thrust bearings.

Montgomery & Co., 104 Fulton St., New York City. Price sheet entitled "Odds and Ends," giving sizes and prices of arbors, bolts, hacksaw blades, blocks, broaches, chucks, cutters, dressers, drills, extinguishers, files, holders, screws, screwdrivers, taps, tapes, carpenters' and woodworkers' tools, and other tools, supplies and machinery made by this company.

Nordberg Mfg. Co., Milwaukee, Wis. Bulletin 28, covering the Nordberg line of poppet valve engines, which includes three types, namely, full poppet, poppet-uniflow and poppet Corliss. The engine best suited for the purpose is recommended in each case. In addition to describing the construction of the different types of engines the book gives results of tests made on these engines.

Draeger Oxygen Apparatus Co., 422 First Ave., Pittsburg, Pa. Folder descriptive of type B pulmotor, a hand-operated resuscitation device, insuring a safe and efficient pressure. This type of pulmotor is equipped with a regulating valve by means of which air is allowed to escape to any degree desired, reducing the inhalation pressure as shown by the indicator gage.

Hub Machine, Welding & Contracting Co., 22nd and Race Sts., Philadelphia, Pa. Circulars illustrating "Acme" metal saw table in two sizes. Table No. 1 is 18 by 18 inches and takes saws up to 6 inches diameter; table No. 2 is 22 by 24 inches and takes saws up to 10 inches diameter. These machines are being used extensively at present for cutting copper cartridges. They are also specially designed for cutting copper shells and tubing, brass tubing, sheet and rod metal, fiber, rubber, etc.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Circular illustrating Westinghouse reversing motor equipments applied to metal planers. These direct-connected reversing motors have 4 to 1 speed adjustment by field control, and the controller gives fine speed increments. The circular points out the advantages resulting from the use of reversing motors on planers and other machines having reciprocating motion.

Phoenix Mfg. Co., Eau Claire, Wis. Catalogue of Conradson geared-head engine lathes, geared-head projectile lathes and geared-head special lathes, built in 21 inches and 28 inches swing. The spindle drive is effected by means of duplex gears and worm-gears of widely varying ratios. The general construction has been worked out to afford the maximum of rigidity and power so that the heaviest cuts may be taken without excessive vibration.

David McLain, Goldsmith Bldg., Milwaukee, Wis. Booklet on McLain's semi-steel, showing semi-steel castings in wide variety and illustrating the superior physical characteristics of semi-steel consisting of 30 to 50 per cent steel which is claimed to have a tensile strength of 34,000 to 38,000 pounds. Booklet containing synopsis of McLain's System which comprises information and instructions in a set of twelve printed lessons covering gray iron mixtures, cupola practice and the making of semi-steel.

J. T. Slocomb Co., Providence, R. I. Catalogue 15 covering complete line of Slocomb micrometer calipers and center drills. The latter half of this catalogue is called, "The Measuring Book," and contains suggestions in regard to accurate and economical measuring in machine construction by the use of micrometer calipers. This section of the book is illustrated with halftone and line engravings, making the matter very clear, and contains much useful material including tables of decimal equivalents, tap drill sizes, speeds for twist drills, diameters of centers, sizes of center drills and speeds, etc.

Sweet's Catalogue Service, Inc., 115-119 W. 40th St., New York City. Second annual edition of Sweet's engineering catalogue which contains a collection of condensed catalogues, comprising materials of construction, contractors' plant, power plant equipment and allied products, completely indexed with cross references. The catalogues cover 823 pages, 8½ by 12 inches. The index is divided into three parts, the first part containing the manufacturers' names, the second part, classified list of products and the third part, trade names. The catalogue also contains a specification digest for aid in specification writing. This is intended for use in connection with the power plant section and occupies 80 pages.

American Pulley Co., 4208-60 Wissahickon Ave., Philadelphia, Pa. Booklet entitled, "Belt Pulleys," by Charles A. Brinley, a reprint of a paper read before the Engineers Club of Philadelphia, June 20, 1916. This booklet contains valuable pulley information including data of the results of tests on pulleys made at the American Pulley Co.'s plant, under the supervision of William W. Crosby. The company has also issued another booklet entitled, "Belt Pulleys—Report of Tests for Belt Slip," by H. M. Haven and William W. Crosby. The object of the tests was to determine the slip in feet between a belt and the face of a pulley when the belt was transmitting different known horsepowers to the pulley. The apparatus used is illustrated and the results of the tests are tabulated. These booklets will be sent free on request to those interested.

TRADE NOTES

Abbott Ball Co., Hartford, Conn., has let the contract for an addition to its ball bearing plant, two new buildings now being under way.

Hoskins Mfg. Co., 459 Lawton Ave., Detroit, Mich., has changed its Boston office from 185 Devonshire St. to 445 Tremont Bldg., 73 Tremont St.

Wagner Electric Mfg. Co., St. Louis, Mo., has moved its Detroit office to 1291 Woodward Ave. The office will continue to be in charge of Dean Emerson.

Newman-Andrew Co., American representative of Jno. Hy. Andrew & Co., Ltd., Toledo Steel Works, Sheffield, England, has moved from 107 West St. to larger offices at 26 Cortlandt St., New York City.

Ready Tool Co., 654 Main St., Bridgeport, Conn., has purchased a plot on the corner of Railroad Ave. and Iranistan St., Bridgeport, and has placed a contract for the erection of a brick factory building, to begin at once.

Brown & Sharpe Mfg. Co., Providence, R. I., will close from July 28 to August 8 for the annual vacation. During this time the offices will be open as usual, and orders for machine tools, machinists' tools and cutters will receive the same attention as at any other period of the year.

W. H. Nicholson & Co., 112 Oregon St., Wilkesbarre, Pa., secured an order for 1017 Nicholson compression shaft couplings for 2 7/16-inch shafting from the Remington Arms & Ammunition Co. for the ordnance plant at Ilion, N. Y. The Nicholson couplings are of the four-jaw compression type which is applied without milling keyways in the shafting.

National Twist Drill & Tool Co., Detroit, Mich., is erecting a three-story concrete and brick office building, 42 by 81 feet. A four-story factory addition, 45 by 76 feet, with L-connection to the office building 45 by 73 feet, is also being erected and is nearly completed. The dimensions given in the July number were incorrect in regard to the factory addition and L-connection.

Glidden Varnish Co., Cleveland, Ohio, has built a large addition of concrete, fireproof construction throughout, affording 27,000 square feet of additional floor space. The addition will be equipped throughout with modern machinery for the manufacture of paints and varnishes. The plant occupies an area of 16½ acres, and the total floor space of the buildings is 190,000 square feet. Complete lines of varnishes and paint specialties are manufactured for the requirements of all industries.

G. Hartmann has opened an office in the Tribune Bldg., New York City, where he will act as representative of the following machine firms in Norway, Finland, Sweden and Russia: G. Hartmann, Ltd., Christiania; Finska G. Hartmanns Maskinaffar, Ltd., Helsingfors; G. Hartmanns Maskinaffar, Ltd., Stockholm; and Christian Christiansen, Petrograd and Moscow. He will act as agent for the purchase of metal working machinery, machine tools, metals, tubing, crucibles and other materials required in general manufacture.

Russo-Baltic Car Works Co., Room 242, Metropolitan Tower, 1 Madison Ave., New York City. The company, which was incorporated in Petrograd, Russia, has sent a commission to America for the purpose of purchasing materials and machines for the company's new automobile plant in Russia, and not for the purpose of purchasing materials for the manufacture of railway cars and other railway equipment. The commission invites all concerns offering machinery, etc., for the manufacture of motor cars to send catalogues and printed matter descriptive of their products.

Diamond Chain & Mfg. Co., 240 W. Georgia St., Indianapolis, Ind., has begun the erection of a complete manufacturing plant on a six-acre tract of land located on Kentucky Ave. The new structure will be of concrete, four stories high, with 150,000 square feet floor space. The main building will be 380 by 60 feet with two L's 100 feet long, making the entire frontage 700 feet. A power plant and auxiliary buildings will be located in the L's. It is expected that the buildings and new equipment will double the present capacity of the plant. Plans, specifications, engineering and construction are in charge of Westinghouse, Church, Kerr & Co.

Cincinnati Milling Machine Co., Cincinnati, Ohio, gave a birthday party to its employes at the Cincinnati Zoological Garden, July 1, in honor of the fiftieth birthday of the president, Frederick A. Geier. About 4200 employes and members of their families accepted the invitation and participated in the events. The program included a shoe race, potato race, three-legged race, sack race, tug of war, ladies' and gentlemen's race, track race around the lake, fifty-yard dash, peanut race for girls, pipe-lighting race for girls and men, flag race, nail-driving contest for women, rolling hoop around the lake (fat men only eligible), donkey driving contest, goat riding pillow contest. The party was voted a great success by all participating.

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THE INDUSTRIAL PRESS, Publishers, 140-148 Lafayette Street, New York

Business is Barter

Business is now so multifarious and complex that we forget its essentially simple function, which is barter—the exchange of commodities. This fundamental, unchanging principle is often and easily lost sight of in modern commercial business. The ancient custom of barter has worked up into a vast world-wide business, involving an incalculable number of transactions, but the purpose and effect of it all is as single and simple as was the barter of Long Island land by Wyandanch, the Indian Chief, for twenty-four English knives, coats and axes.

Some of the people who are speculating about what will happen after the war seem to forget that all business is barter. They are afraid our markets will be cluttered, that we must buy, but cannot sell. When hostilities cease, vast numbers of workers engaged in unproductive and destructive warfare must take up again the tools of industry to live and to produce the *commodities* needed to pay hereafter for the unproductive time they have spent, and the destruction they have caused. There is absolutely no other way. Most of what has been spent for the war is still owed for, and the new securities are merely *titles to commodities to be produced hereafter* by the peoples now at war. European statesmen and thinkers understand this and are instituting plans, accordingly. Russia, for example, is preparing to develop her industries to the utmost. She knows it is through the labors of her people that her debts will be paid, her wealth produced, and in no other way. So she is laying down great works for the development of her industries and great railways for the distribution of the commodities they will produce. That land alone represents a vast new market for American products. And all the others will come into the world's markets with the products peculiar to their soil, the quality and variety of which make the market and enliven the traders. They come to the market to *trade*, to *barter*, not merely to sell. With the revival of production, with exchange universal, free, untrammeled, there should be an era of extraordinary industrial development throughout the world, and great opportunities for the enterprising and wide-awake.

The Largest Exclusive Builders of Upright Drilling Machines in the United States

THE SNYDER Drilling Machines have great range of feed, being nearly double that on other makes. Especially adapted to boring long holes. Strong gear feed; main column and back brace with one exception is one solid piece of casting. Very accurate, rigid and powerful. Great producers.

Send for New Catalog *For Sale by Machine Tool Dealers*

J. E. SNYDER & SON, Worcester, Mass., U. S. A.

This Leland-Gifford

Trebled the Best Previous Production

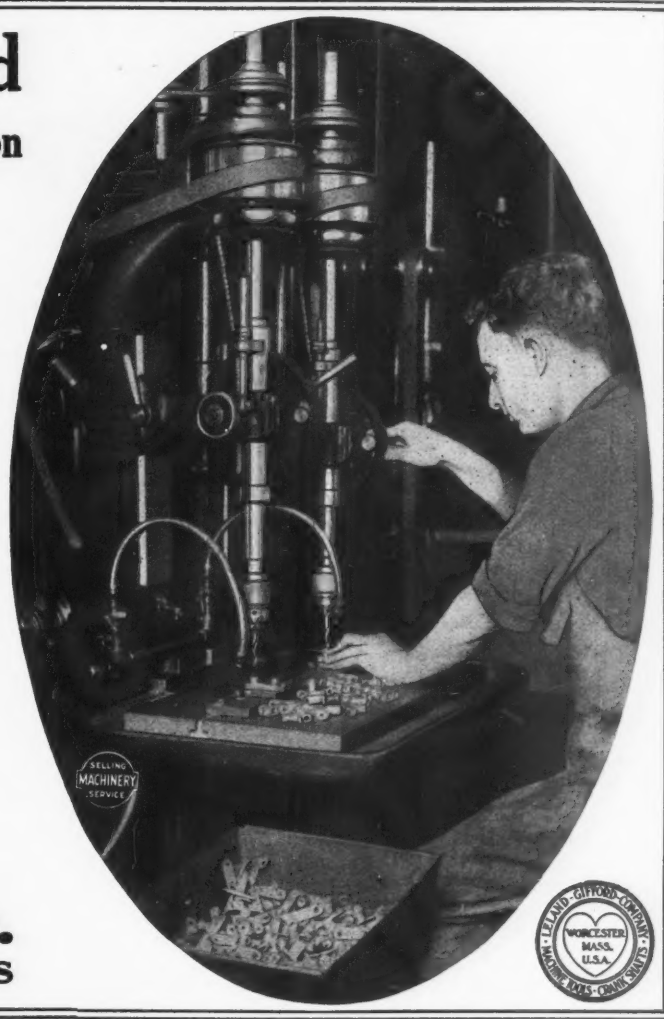
The Willys-Overland Company (Toledo plant) formerly drilled these malleable iron brackets on a single spindle machine at the rate of 1300 in 9 hours.

A two spindle "Leland-Gifford," fitted with Power Feed Attachment, now drills 4000 pieces in the same time and at the same labor cost.

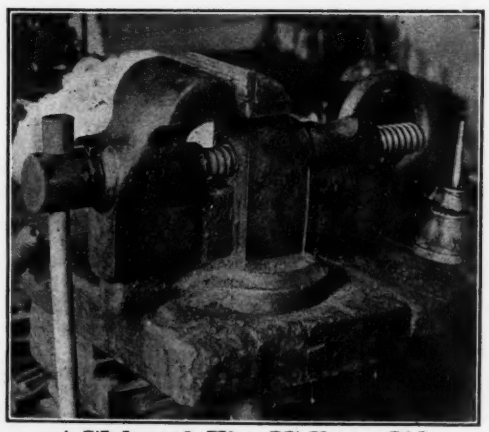
The holes are 5-16" diameter, 3-16" deep.

Doubling the number of spindles in this particular case more than trebled production. Perhaps a "Leland-Gifford" Drilling Machine could do as much for you. We'll be glad to offer suggestions if you'll send samples or blue prints.

Leland-Gifford "Sensible Sensitive" Drilling Machines can be furnished either with or without Power Feed Attachment. Many other features. Send for circulars.



Leland-Gifford Co.
WORCESTER MASSACHUSETTS



A Walworth Vise 27 Years Old

THE WALWORTH VISE

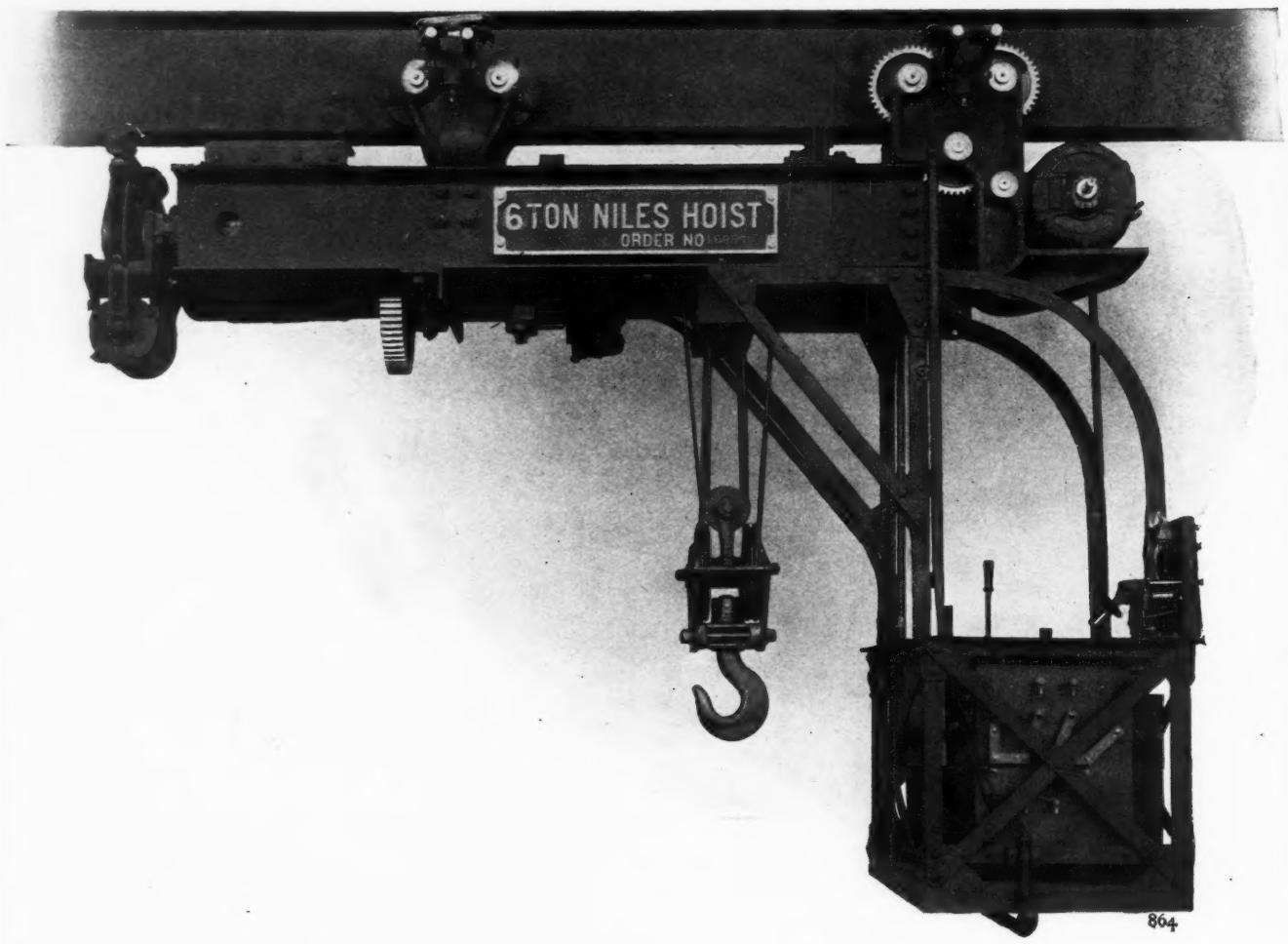
WEIGHT 73 POUNDS

Unequaled for Pipe Work
Unexcelled for Machine Work
Stays on the Job for a Generation

WALWORTH MANUFACTURING CO.
New York BOSTON, U. S. A. Chicago

Mono-Rail Trolley Hoist

Load carried from one point to any other by transfer bridge and I-beam tracks



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THE single I-beam track on which the trolley runs can be arranged in an almost endless variety of ways; spur tracks can be run out at intervals over the gallery floor; a track may be curved around to run lengthwise of the gallery floor; tracks may be run off to the various buildings of an extensive plant; tracks may be run either across or lengthwise of railway sidings, for the unloading of cars. The cage for the operator is attached to the trolley so that he is always with the load.

Write for our 90-page Catalog, "Niles Electric Traveling Cranes," showing various uses to which the above trolley is being applied.

NILES-BEMENT-POND COMPANY

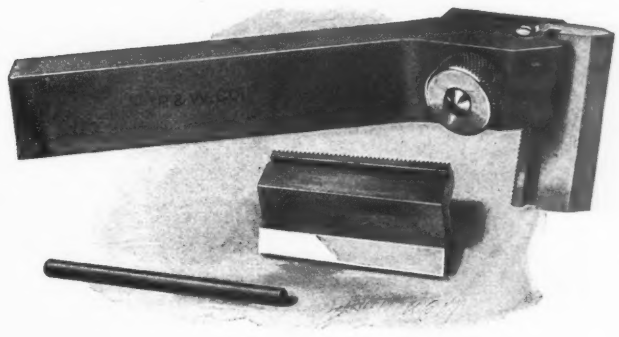
111 Broadway, New York City **25 Victoria St., London, S. W.**

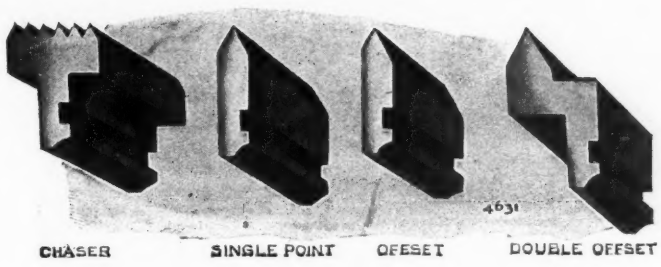
SALES OFFICES AND AGENCIES—Boston: 93-95 Oliver St. **Philadelphia:** 405 N. 21st St. **Pittsburgh:** Frick Bldg. **Cleveland, O.:** The Niles Tool Works Co., 730 Superior Ave. **Hamilton, O.:** The Niles Tool Works Co. **Cincinnati:** The Niles Tool Works Co., 336 W. Fourth St. **Detroit:** Kerr Machinery Bldg. **Chicago:** W. Washington Blvd. and N. Jefferson St. **St. Louis:** 516 N. Third St. **Birmingham, Ala.:** 2015 First Ave. **San Francisco:** 16 to 18 Fremont St. **For Colorado, Utah, Wyoming and New Mexico:** Hendrie & Bolthoff Manufacturing & Supply Co., Denver. **For Seattle, Wash.:** Hallidie Machinery Co. **For Canada:** The John Bertram & Sons Co., Ltd., Dundas, Montreal, Winnipeg, Vancouver. **Japan:** The F. W. Horne Co., 6 Takiyama-cho, Kyobashi-ku, Tokio. **Italy:** Ing. Ercole Vaghi, Milan. **France:** Glaenzer & Perreaud, 18 Faubourg du Temple, Paris. **Russia:** S. G. Martin & Co., Ltd., Petrograd and Moscow. **Holland:** R. S. Stokvis & Zonen, Ltd., Rotterdam. **Brazil:** Comptoir-Technique Bresilien, P. O. Box 802, Rio de Janeiro.

One Holder for Chasers and Single Point Cutters

and the change can be made in a jiffy on the

P. & W. THREADING TOOL





A Few of its Advantages:

1. Threads can be cut very close to a shoulder.
2. Tools are sharpened by simply grinding off top of cutter.
3. Combines economy with all features essential in a threading and forming tool.
4. Cutters have 15° clearance which experience has taught gives the longest wear in various metals.

Place a trial order with our nearest store.

PRATT & WHITNEY COMPANY
HARTFORD, CONNECTICUT

OFFICES AND AGENCIES CARRYING P. & W. SMALL TOOLS IN STOCK:

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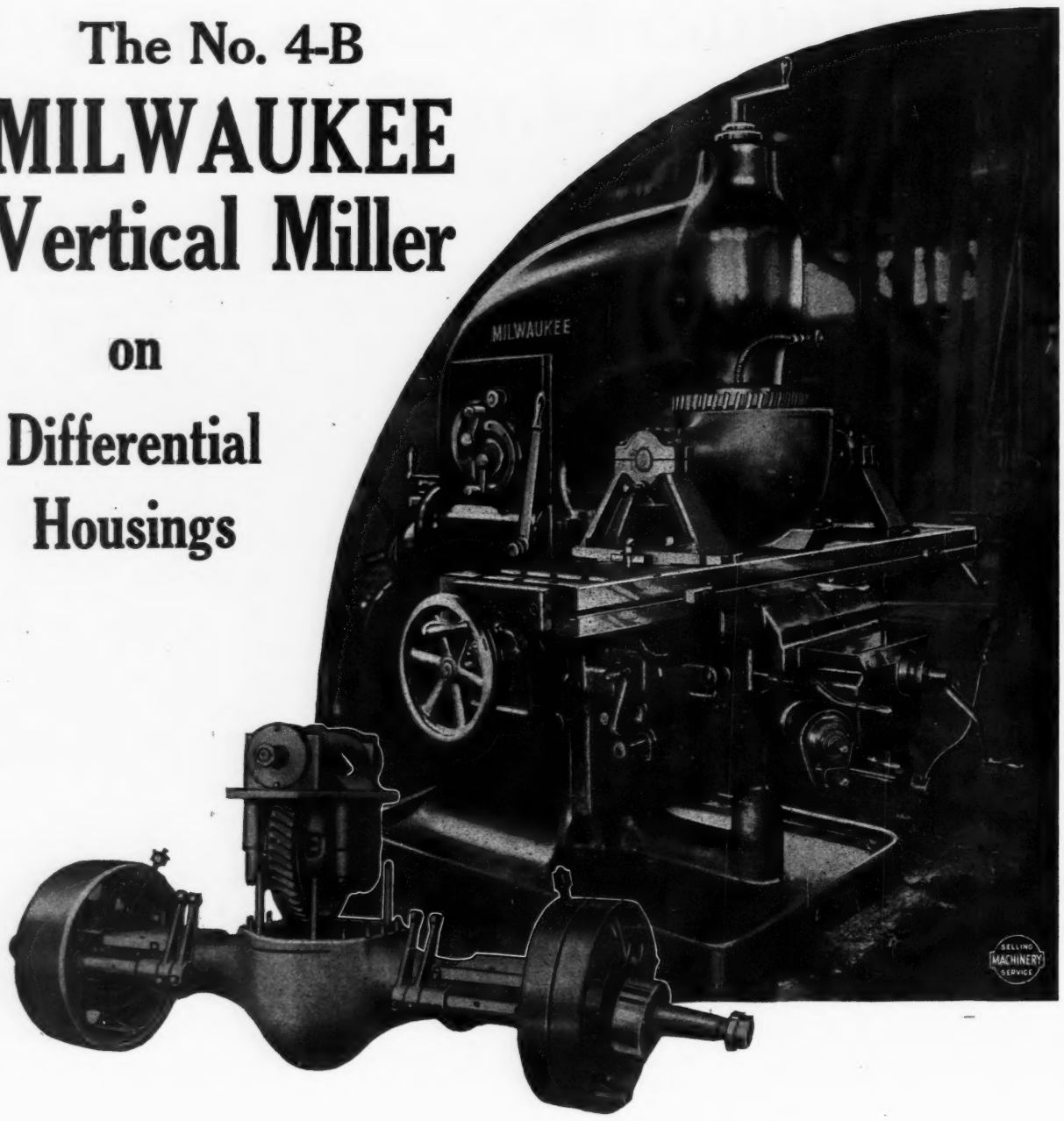
NILES CRANES

2 to 200 Tons Capacity
Write for Catalog

NILES-BEMENT-POND COMPANY
111 Broadway, New York City **25 Victoria St., London, S. W.**

For Full List of Offices and Agencies See Opposite Page.

The No. 4-B MILWAUKEE Vertical Miller on Differential Housings



The Sheldon Axle & Spring Company, Wilkesbarre, Pa., installed this Milwaukee Miller over two years ago. It has given excellent service on high-grade work.

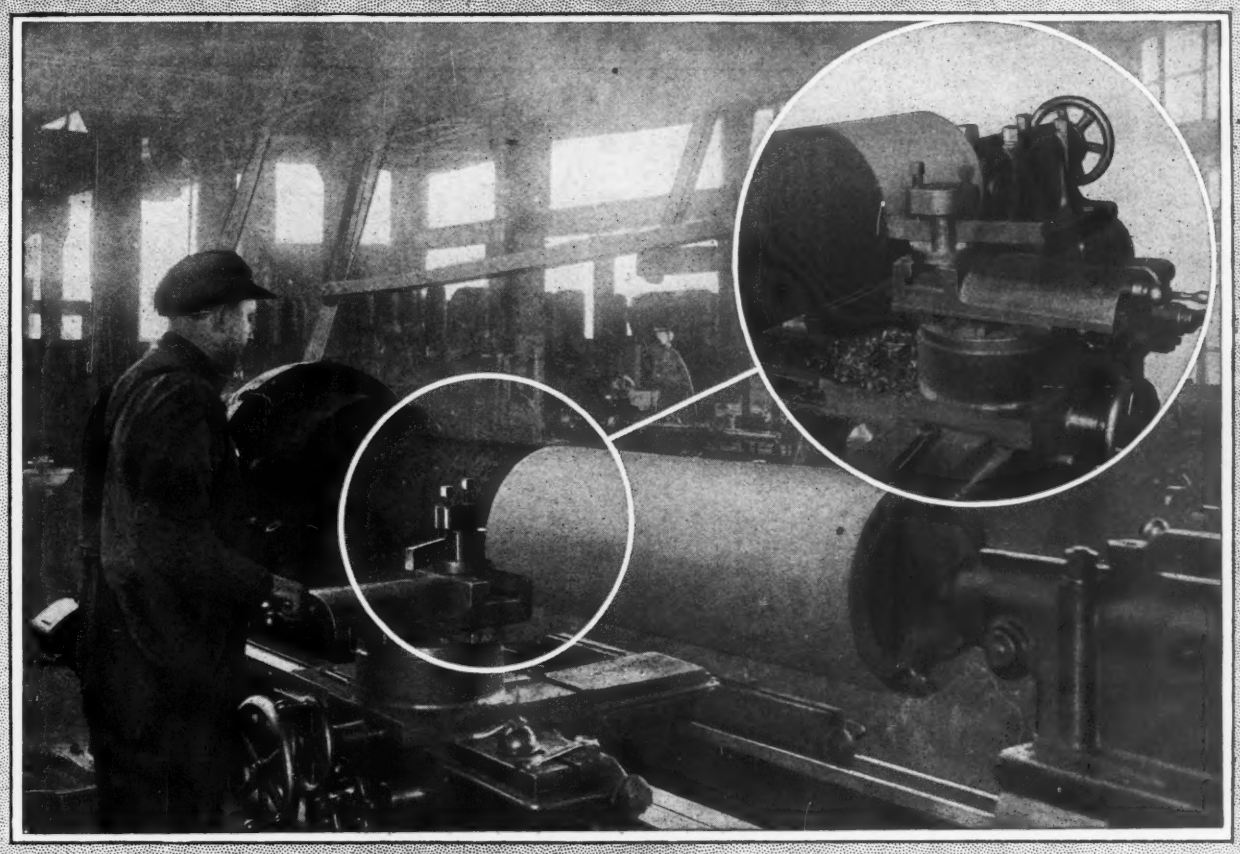
The outside dimensions of the surface to be milled on this housing are 20″ by 15″ and the amount of material to be removed varies from 1-8″ to 3-16″ in depth. The hourly production on this job is two completed housings. The distance from the center of the housing to the face being milled must be held within a limit of 0.005″. The diameter of the cutter used is 17 inches.

The rigid construction of the Milwaukee Vertical Milling Machine makes it possible to do a job of this kind without the slightest indication of chatter. If Milwaukee Millers will give satisfaction on this kind of work are they not worthy of your investigation?

KEARNEY & TRECKER COMPANY

MILWAUKEE, WISCONSIN, U. S. A.

LODGE & SHIPLEY LATHES

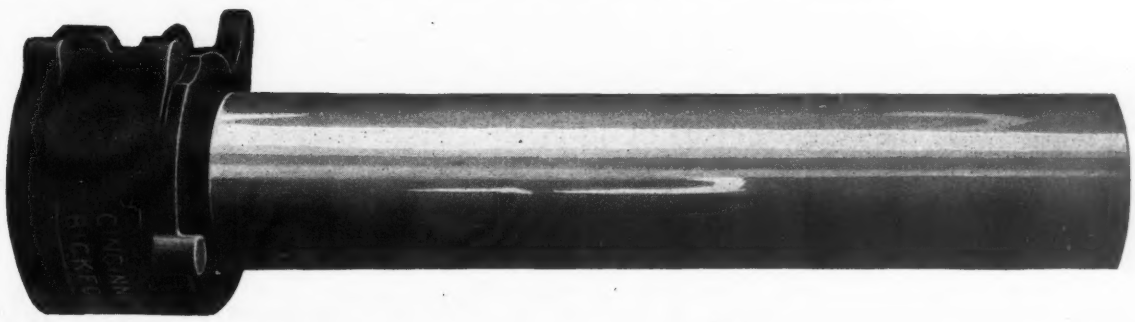


THE TOOL STEEL IS THE ONLY LIMIT

Says the Cincinnati Bickford Tool Company

OF THIS LODGE & SHIPLEY LATHE

They know for they rough and finish these Cast Iron Columns for their Radial Drills on this lathe. ¾-inch stock is removed and ⅛-inch feed is used. Don't you want to know what this lathe will do on your work?



THE LODGE & SHIPLEY MACHINE TOOL CO.
CINCINNATI, OHIO.

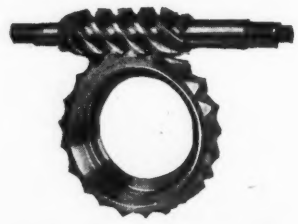
320 SPINDLES!

THIS piano plate drilling layout is probably one of the best illustrations that could be shown indicative of the closeness of drill centers permitted by the use of Baush patent adjustable arms.

Not only is this arm extremely compact, but it can be adjusted anywhere within a 10- x 58-in. layout. Each one of these spindles is provided with an adjustment for different length drills, which adjustment is controlled from the extreme outer end of the arm. This particular head has 80 spindles, the machine complete having 320 spindles.

As in all other of the latest type Baush multiple drills, this arm is free from lugs or projections of any kind so that the centers can be as close as the diameter of the spindle itself.

If you have any work requiring the drilling of two or more holes in quantities, you need a multiple spindle drill of some sort. Our years of specializing in the production of multiple spindle drilling machines have equipped us to solve your drilling problems for you. We will appreciate the opportunity to confer with you.

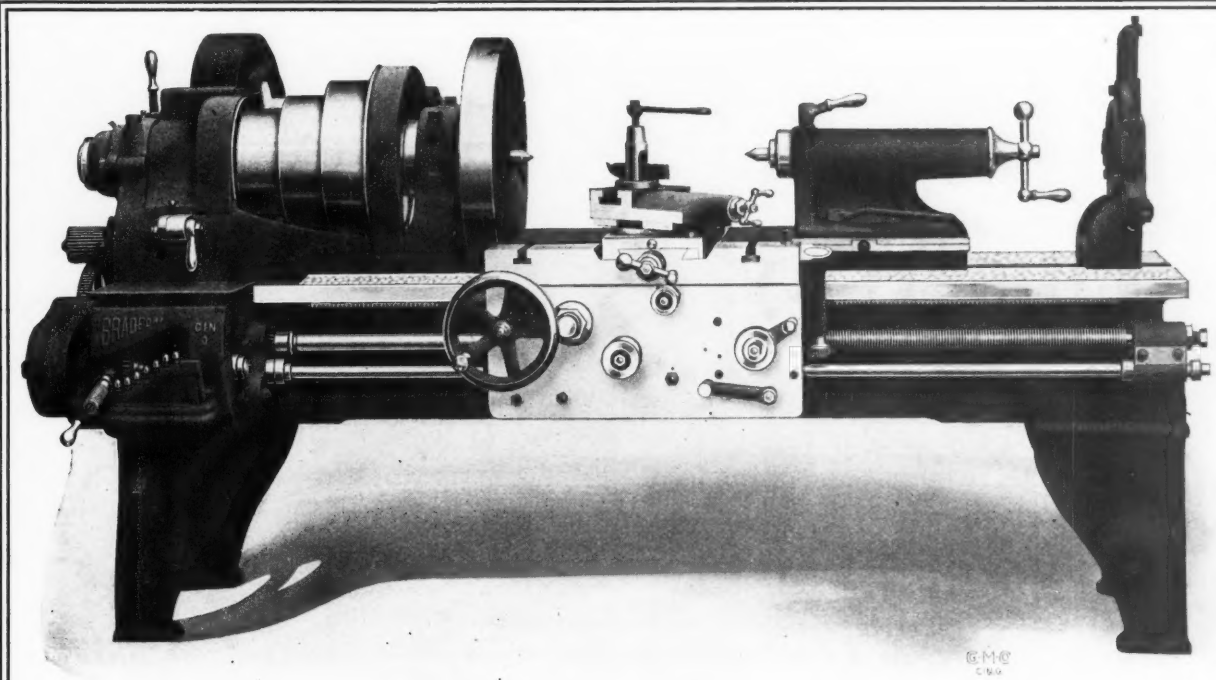


Specialists, also, in the production of worm gear units for motor cars and trucks.

Baush Machine Tool Co., 200 Wason Avenue Springfield, Mass.

New York Office, 50 Church Street

Fenwick Freres & Co., France, Holland, Belgium, Switzerland, Italy, Spain, Portugal. Selson Engineering Co., Ltd., London.



AN UNUSUAL LATHE FOR OUT-OF-THE-ORDINARY WORK

Most shops have their share of troublesome turning and boring jobs—work beyond the power and capacity of the ordinary lathe. That is the kind of work that makes the foreman glad he has a "Bradford" lathe. He can keep the machine busy on ordinary work—producing it quickly too—until the unusual job comes in. "Put those pieces over by that 'Bradford,'" he says. No more trouble on that score. The job is finished on time without difficulty.

Bradford Lathes

are made expressly for that purpose. Heavy construction, compact design, ample power and convenient operation combine to make the day's work easy for the mechanic and profitable for the owner. Sizes from 14″ to 42″ swing. Write for detailed information.

BRADFORD MACHINE TOOL CO.

CINCINNATI, OHIO, U. S. A.

AGENTS: Swind Machinery Co., Philadelphia. Hill, Clarke & Co., Inc., New York. Taylor Machinery Co., Boston, Mass. The H. A. Stocker Machinery Co., Chicago, Ill. Somers, Fitler & Todd Co., Pittsburgh, Pa. The E. A. Kinsey Co., Cincinnati, O., and Indianapolis, Ind. The Mine & Smelter Supply Co., Denver, Colorado. Pacific Tool & Supply Co., San Francisco, Cal.

Figure the "Stewart" This Way

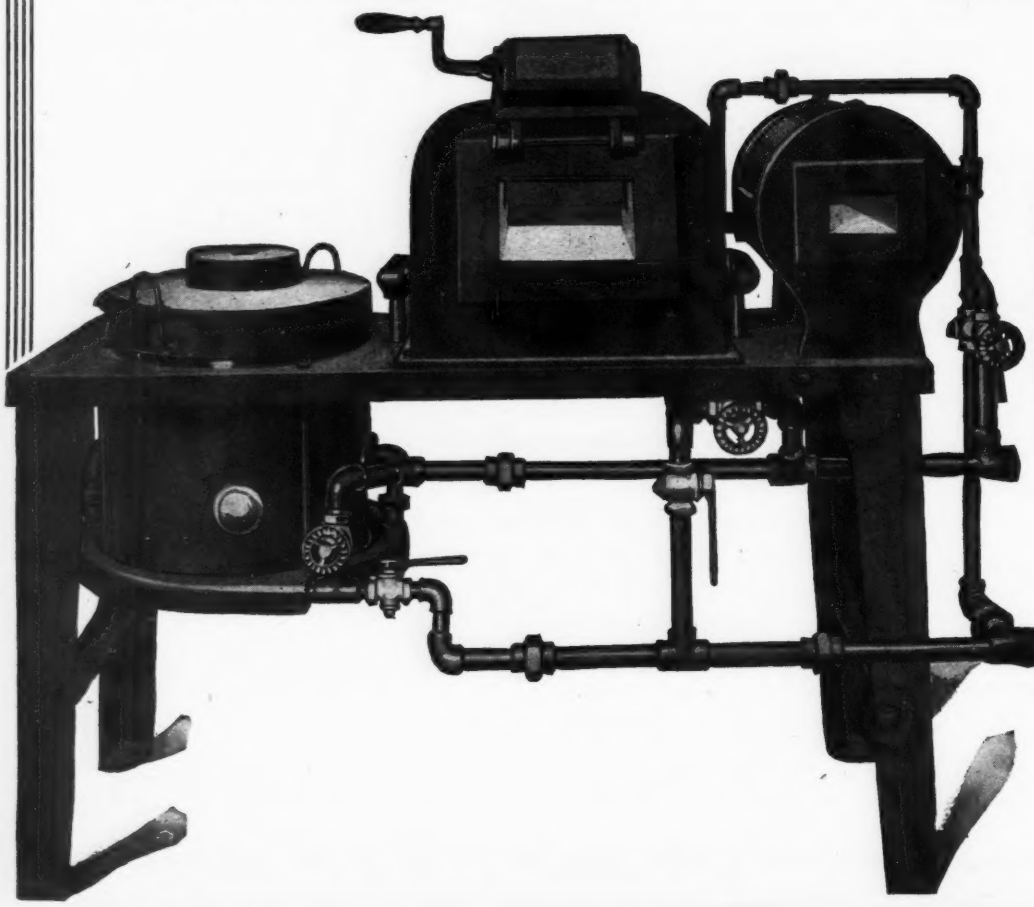
In using a furnace for hardening, heat-treating, etc., the value of the material treated will be hundreds of times the cost of the best furnace you could buy. Then why risk spoiling a large percentage of this expensive steel in a poorly designed furnace when you can be sure of your results with a "Stewart."

The big feature of the "Stewart" line is dependable control. Steel manufacturers, after careful experiments, give detailed instructions as to the treatment of steel, which must be followed carefully to secure the desired results. Temperature control is emphasized. "Stewart" Furnaces give it to a fine degree. There's a "Stewart" for every heat-treating purpose—furnaces you can rely upon for definite, economical results. Try one on your work for 30 days. We are satisfied that it will convince you.

Write for catalogs and conditions of our free trial offer.

Chicago Flexible Shaft Co.

149 West LaSalle Street **Chicago, Illinois**

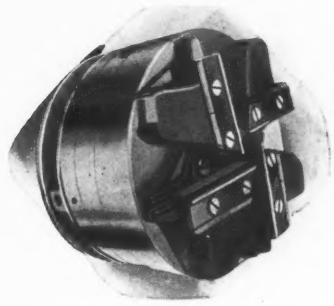


This Stewart Triple-purpose Furnace has three units on one base—barium chloride furnace on the left; "semi-muffle" oven in center; direct heat furnace on the right. Convenient, compact, economical. All compartments suitable for high speed steel.

Another Manufacturer

who uses

LANDIS DIE HEADS Exclusively



The Bridgman Bros. Company, Philadelphia, manufacture a high-grade line of steam fitters' supplies. A large battery of pipe threading and cutting machines is necessarily employed and a goodly number of these are Landis Machines, equipped, of course, with the Landis Die Head. Accurate work at the highest possible speed is the requirement at the Bridgman plant, and a check-up of results showed the Landis installation in the lead.

That was about two and one-half years ago. ***Now every pipe machine in this plant, regardless of make, is equipped with a Landis Die Head.***

One of the jobs on which the "Landis" sets a new production record is cutting off and threading 2½″ x 4″ nipples, threaded1½″ at each end. Have you similar work?

Landis Die Heads are high output tools, made to give long service and to lower threading costs. No hobbing or retempering is required; right and left-hand threads cut with same chasers. Other advantages. *Write for the new catalogue.*

LANDIS MACHINE COMPANY, Inc.

WAYNESBORO, PENNSYLVANIA, U. S. A.

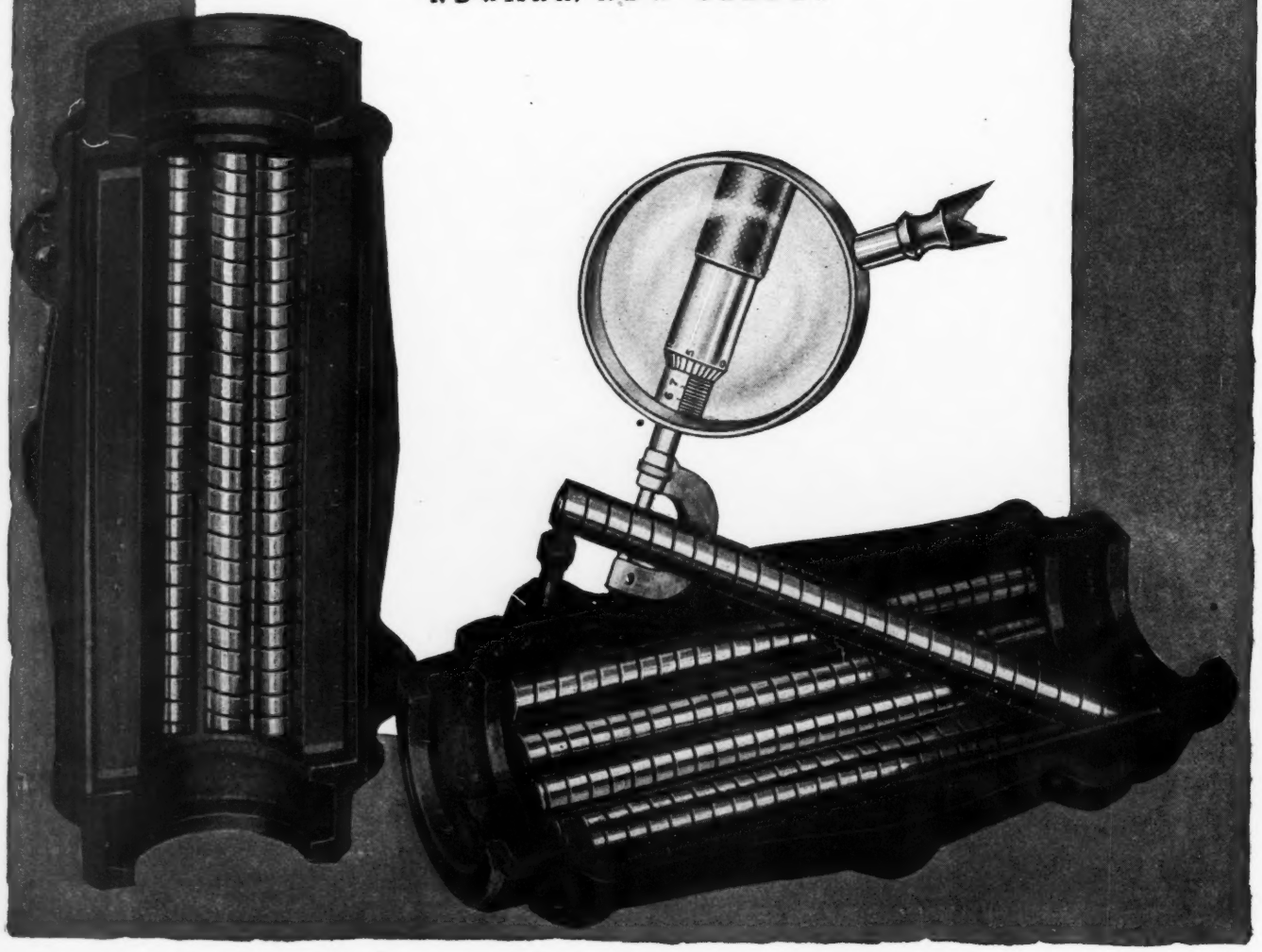
Marshall & Huschart Mchy. Co., Chicago, St. Louis and Indianapolis; Eccles & Smith, San Francisco, Cal.; Los Angeles, Cal., and Portland, Ore.; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.; R. B. Whitacre & Co., St. Paul, Minn.; Hallidie Machinery Co., Seattle, Wash.; Williams & Wilson, Montreal, Canada; Alfred Herbert, Ltd., Coventry, England; Alfred H. Schutte, Berlin, Cologne, Brussels, Bilbao and Barcelona; Ernst Krause & Co., Vienna, Austria; D. Drury & Co., Johannesburg, South Africa; Benson Brothers, Sydney and Melbourne, Australia.

HY·FLEX·ROL
REG. U.S. PAT. OFF.

THIS Hyatt Roller Bearing has been in service 7 years in the plant of the Edison Storage Battery Company, with "no noticeable amount of wear and with no attention but a semi-annual inspection and oiling."

Bulletin 122 will be mailed on request.

HYATT ROLLER BEARING CO.
NEWARK, NEW JERSEY



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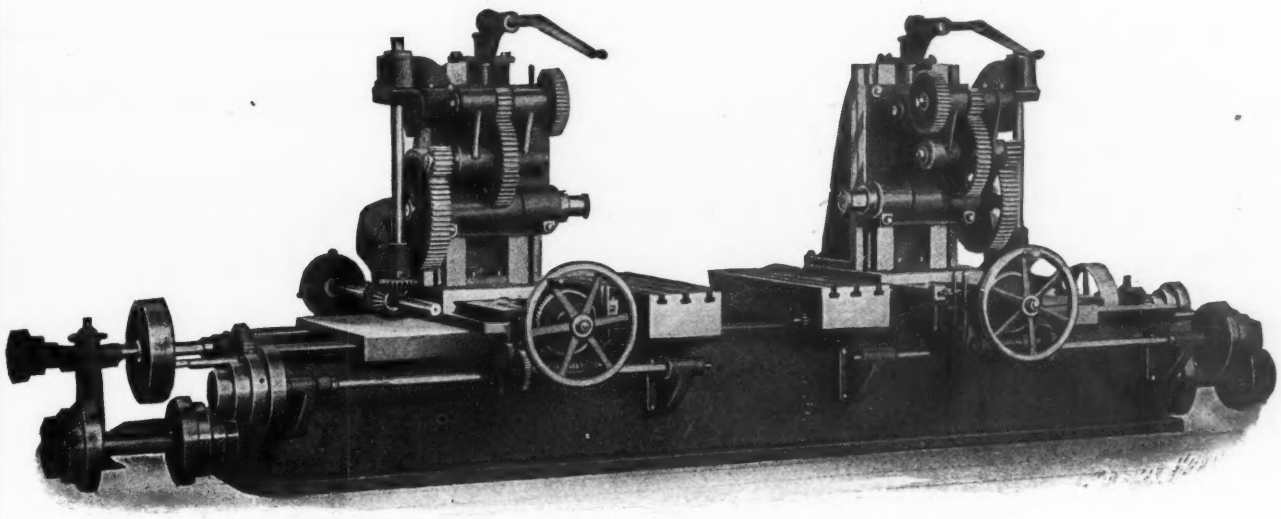


A Look into the Future will Show More "Special" Machinery

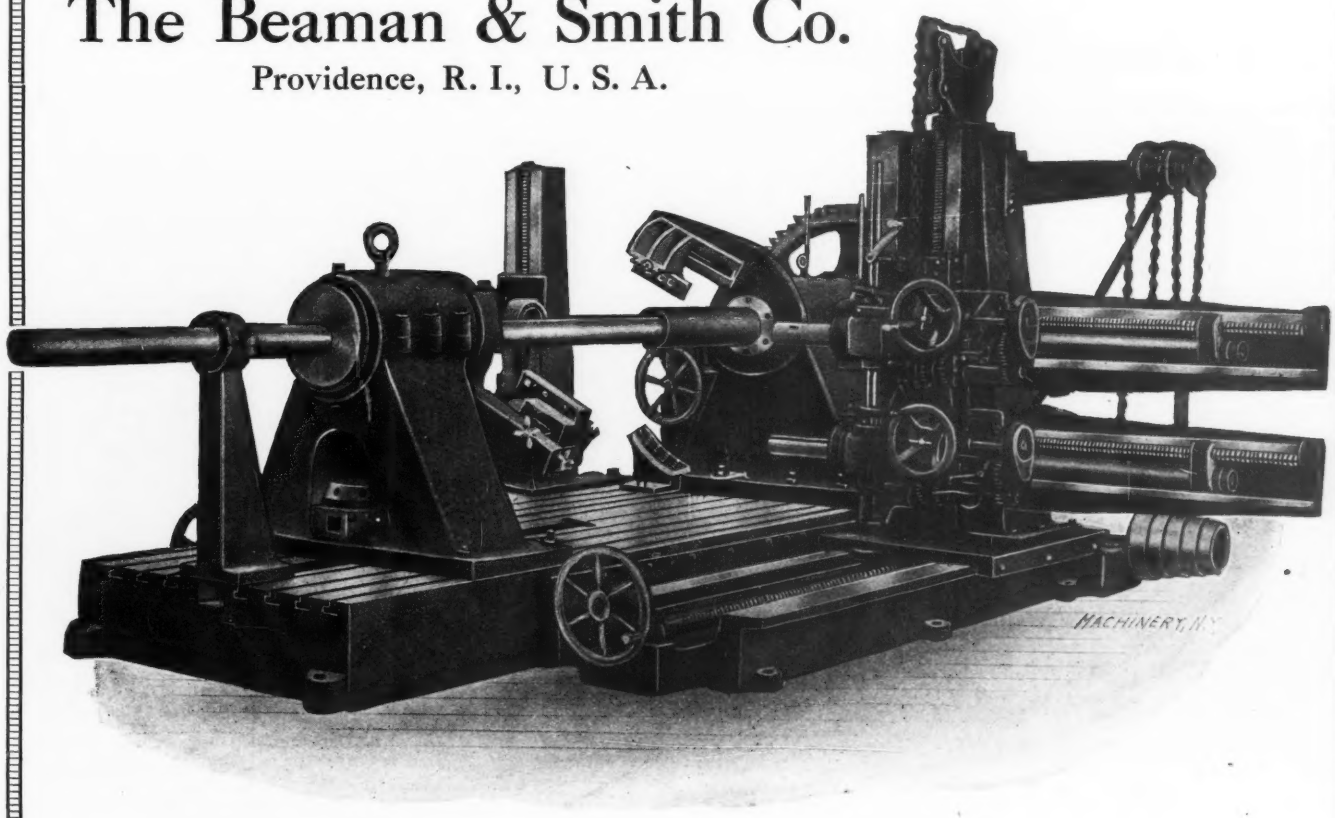
The uses for "special" machines are sure to increase in the future, from the very necessity of things—increasing labor, material, power and other costs, and the demand for cheaper production to offset them.

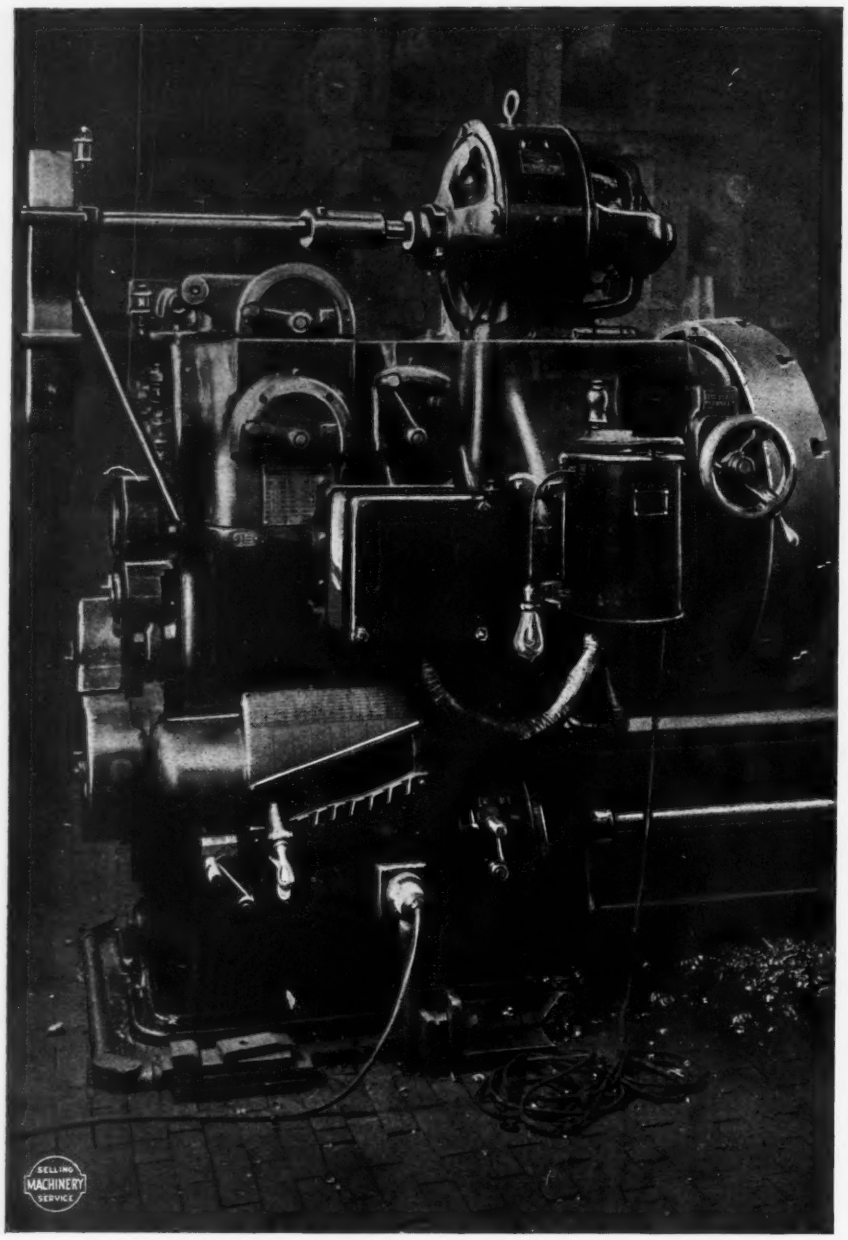
Our "special" Milling and Boring Machines are built to fill the requirements for increased production and accuracy of finish at minimum labor expenditures. We have built them in many different sizes and styles, to meet many and varying conditions—machines that have reduced costs to truly remarkable figures.

A "special" is not advisable unless conditions are right, the quantity of work sufficient, etc. We'll be glad to help you determine.

The Beaman & Smith Co.

Providence, R. I., U. S. A.





Speaking of Heavy Lathes

AMER

Do you know we make a heavy lathe? No? We do, and it's a good one, too—much like other "American" Lathes except for size; just as well built and carefully designed; as popular, too, with the concerns which own them and the men who run them.

The Morgan & Wright Company, Detroit, owns one of these heavy "Americans"—a 42″ lathe that is considered just about the finest ever. The work shown is small compared to some handled on this machine. It is one of four columns for a big hydraulic press for crushing rubber—12″ x 164½″. The diameter is being reduced 1¼″ at 10 R. P. M., ⅛″ feed. Time to complete, 12 hours.

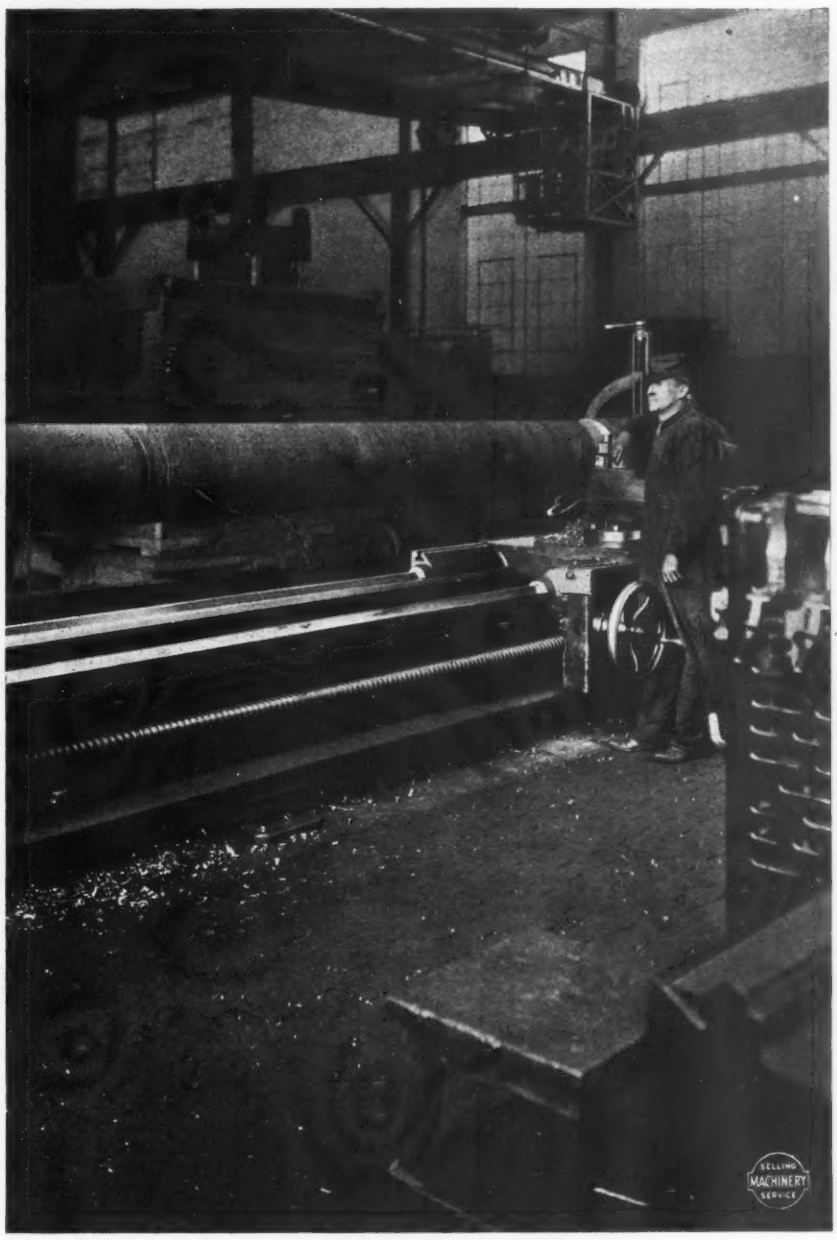
We'll be glad to send complete descriptions.

THE AMERICAN TOOL WORKS COMPANY,

LATHES **SHAPERS** **PLANERS**

That Reminds Us

ICAN



When you buy lathe equipment you can't afford to overlook "American" advantages. Chilled Bed Vees; Bronze Bushes in every cylindrical bearing; Double Plate Apron; Power; Drop Vee Bed Construction; every gear in apron and quick change mechanism of steel—all these features make big productions an accomplished fact.

Cincinnati, U. S. A.

RADIALS

JONES & LAMSON
FLAT TURRET LATHES

**Springfield, Vermont
U. S. A.**

JONES & LAMSON

Germany, Holland, Switzerland, Austria-Hungary, M. Koyemann, Charlottenstrasse, 112 Dusseldorf, Germany.

Speed is Not the Only Advantage of the Flat Turret Lathe

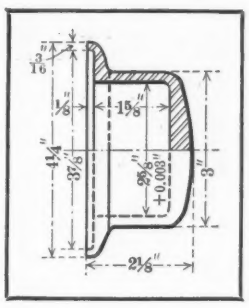
Among the many users of Flat Turret Lathes there is, probably, no better satisfied concern than the Bessemer Gas Engine Company, Grove City, Pa. We've shown, in past advertisements, several pieces of work performed on the three Single Spindle Flat Turret Lathes which comprise the Bessemer installation. The valve cap shown below is another good example of this work.

Writing us about these machines, President John Carruthers of the Bessemer Company says:

> "Rapid production is not the only good quality of your machines, for they can be set to limits of within one thousandth of an inch and turn out work in duplicate, a very great advantage in our line. We have found them very valuable in this respect in machining parts for our new line of No. 4 oil engines which we are making up in sizes of from 20 to 165 H. P. and which require close machining on the valve and pump fittings. We also use these machines almost exclusively on the valve work for our line of air compressors and gas engines."

A satisfied customer is the best advertisement—can you doubt the satisfaction in this case?

The valve cap is made from machine steel which is first cut off into blocks. The first operation is to turn the small end, taking a cut 9-16″ deep with a feed of 0.033″ per revolution at a cutting speed of 99′ surface speed per minute. The finishing cut is taken at the rate of 203′ surface speed, using a J & L standard box turner. The second operation is to turn the large end and bore the 2⅝″ hole. This is done with a large boring tool, made from Novo Superior Steel, in one cut. The most interesting facts about this job are the comparative engine lathe and flat turret lathe production figures. The former time on the engine lathe was 45 minutes for each piece. Flat Turret Lathe time is 19 minutes. A saving of 26 minutes on each piece.

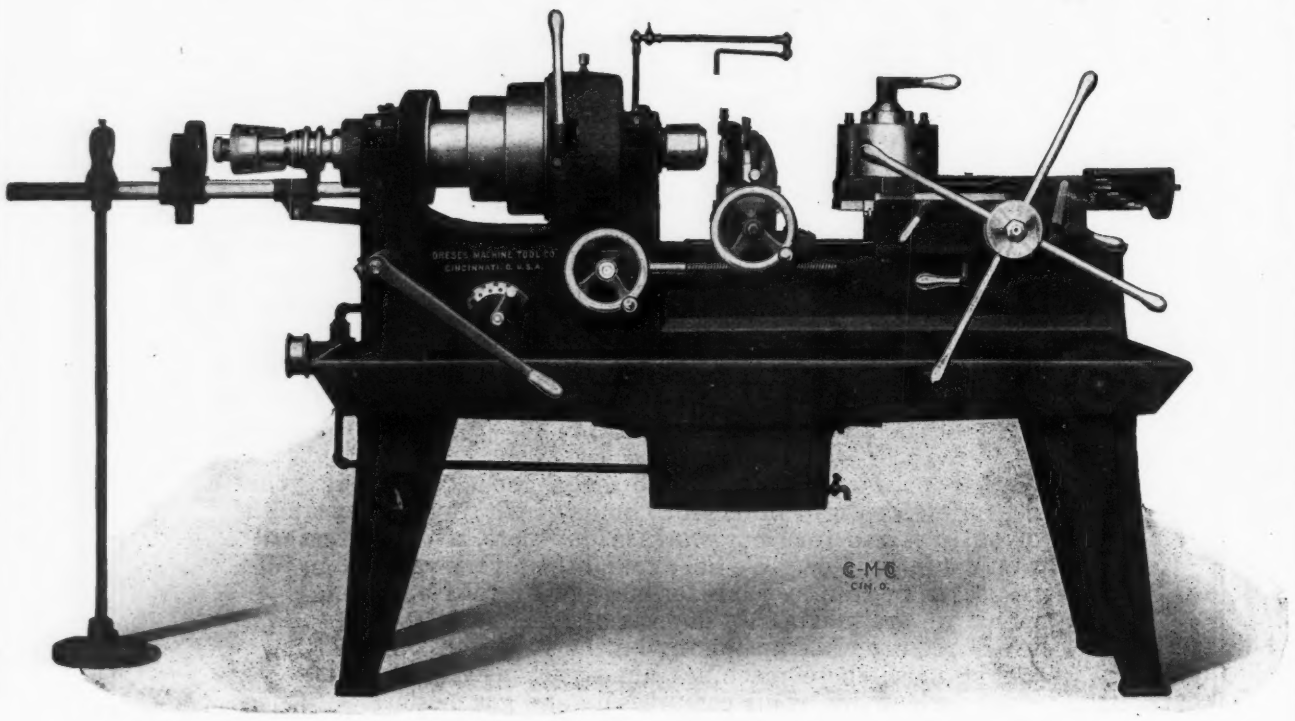


MACHINE COMPANY
97 Queen Victoria St.
London, E. C.
France, Spain, Belgium, F. Auberty & Co., 91 Rue de Maubeuge, Paris.

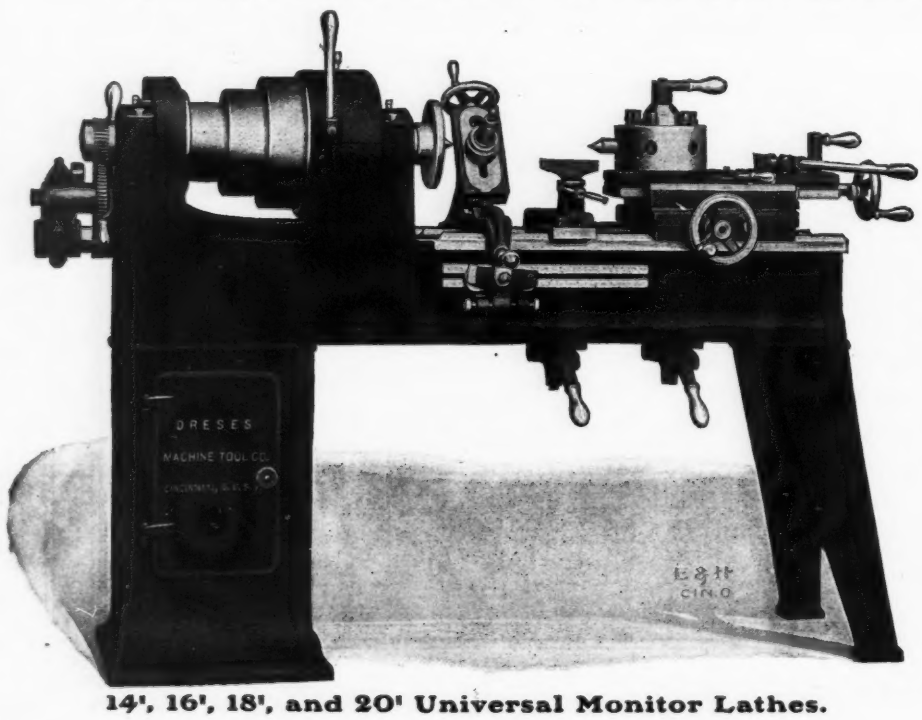
Design and Quality

DISTINGUISH OUR

TURRET LATHES



1', 1 1-2', 2 1-4' Screw Machines. 13', 15', 18' Turret Brass Lathes.



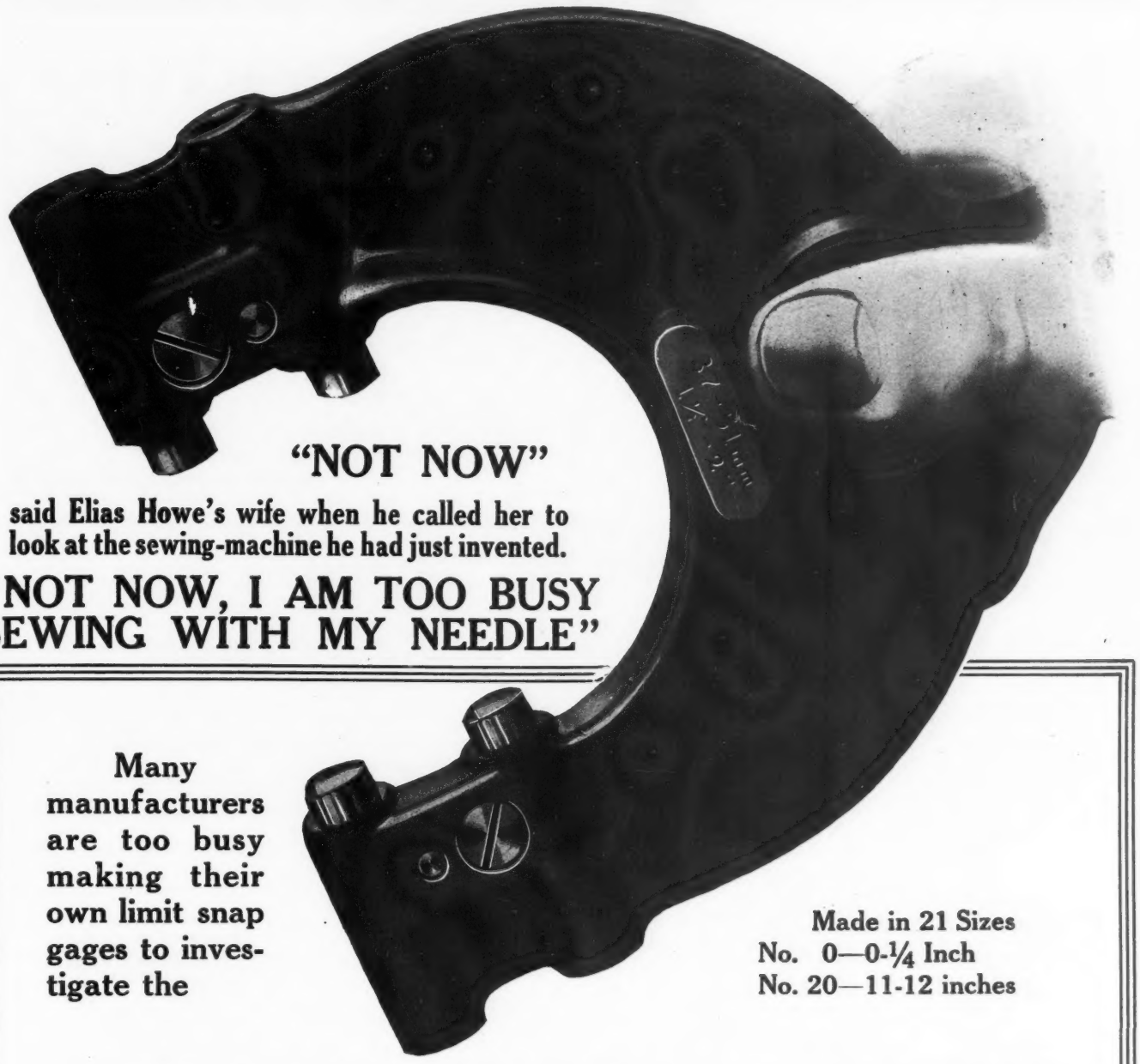
14', 16', 18', and 20' Universal Monitor Lathes.

We build complete lines of all styles

DRESES MACHINE TOOL CO.

CINCINNATI, OHIO, U. S. A.

REPRESENTATIVES: The Fairbanks Co., New York, Boston, Philadelphia and Buffalo; Carey Machinery & Supply Co., Baltimore; E. L. Essley Machinery Co., Chicago; Badger-Packard Mchy. Co., Milwaukee; Wm. C. Johnson & Sons Mchy. Co., St. Louis; The Chas. A. Strelinger Co., Detroit; Canadian Fairbanks-Morse Co., Montreal and Toronto; Selson Engineering Co., Ltd., London; E. Sonnenthal, Jr., Berlin and Koln; Stussi & Zweifel, Milan, Italy; Manning, Maxwell & Moore, Inc., Mexico City and Yokohama, Japan.



"NOT NOW"

said Elias Howe's wife when he called her to look at the sewing-machine he had just invented.

"NOT NOW, I AM TOO BUSY SEWING WITH MY NEEDLE"

Many manufacturers are too busy making their own limit snap gages to investigate the

Made in 21 Sizes
No. 0—0-¼ Inch
No. 20—11-12 inches

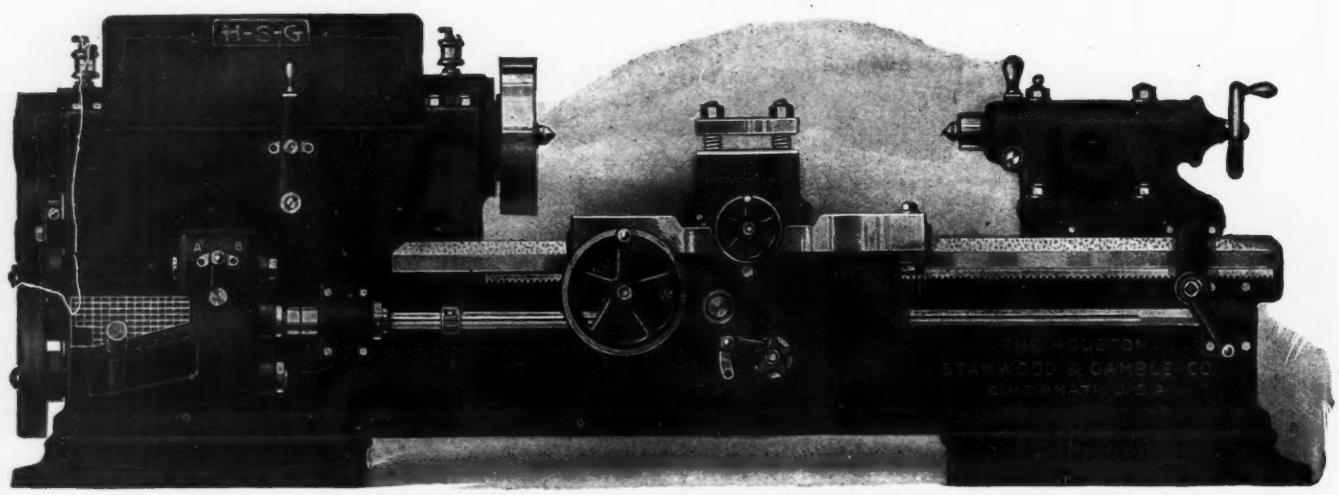
JOHANSSON GAGES

The continuous making and repairing of limit snap-gages is expensive. The Johansson is adjustable for wear, different sizes and changing limits. The saving is apparent.

Notice the design and construction of the Johansson. Sealing prevents the operator from tampering with the adjustment. Let us tell you about it—or send us a trial order. Investigate! Don't be like Elias Howe's wife.

Your request brings full information. Our catalog also describes the famous Johansson Standard Gages.

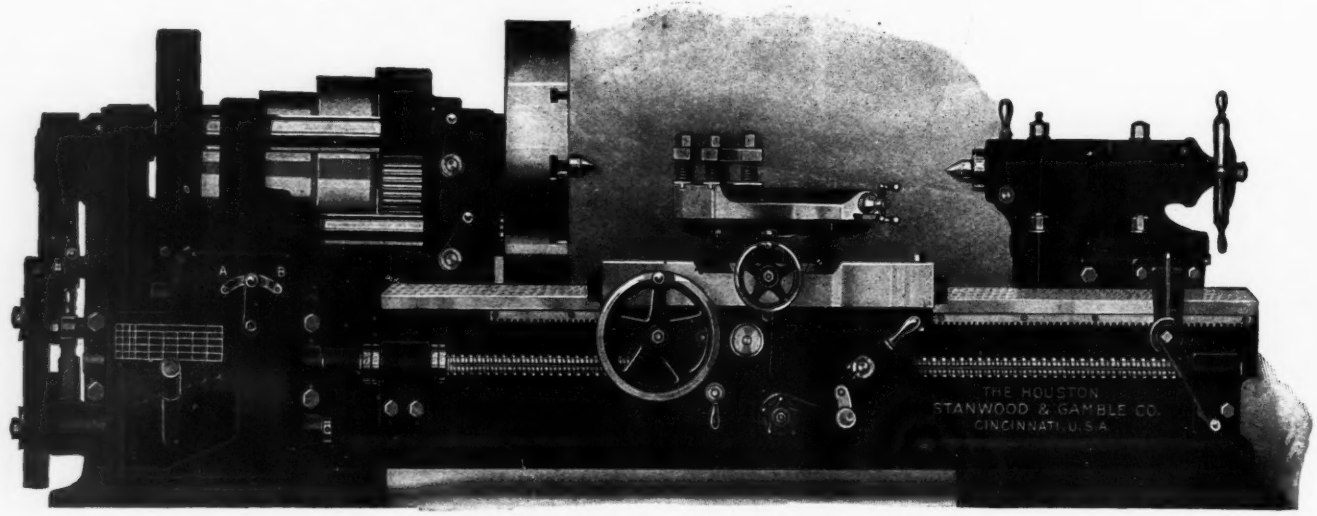
GRONKVIST DRILL CHUCK CO.
20 MORRIS STREET **JERSEY CITY, N. J.**



We can make Prompt Shipment of this Lathe in Three Sizes, 26-inch, 30-inch and 36-inch swing

Also Immediate Shipment of a Number of 26" Special Purpose Lathes

It is an extraordinarily heavy, high-powered lathe. Width of drive belt, 6". Spindle is 7" diam. in 26" lathe, and is of 8" diam. in 30" and 36" lathes. All gears whatsoever are of steel.



Prompt Shipment of this Heavy Duty Engine Lathe in Two Sizes, 30-inch and 36-inch swing

Steps of cone, 7" wide for 6" belt. Triple geared with internal gear in face-plate. Front spindle bearing, 8" x 10". All parts of correspondingly liberal proportions. Absolutely all gears are of steel. Net weight of 36" lathe with 14' length of bed is 19,000 pounds.

H-S-G TRADE MARK

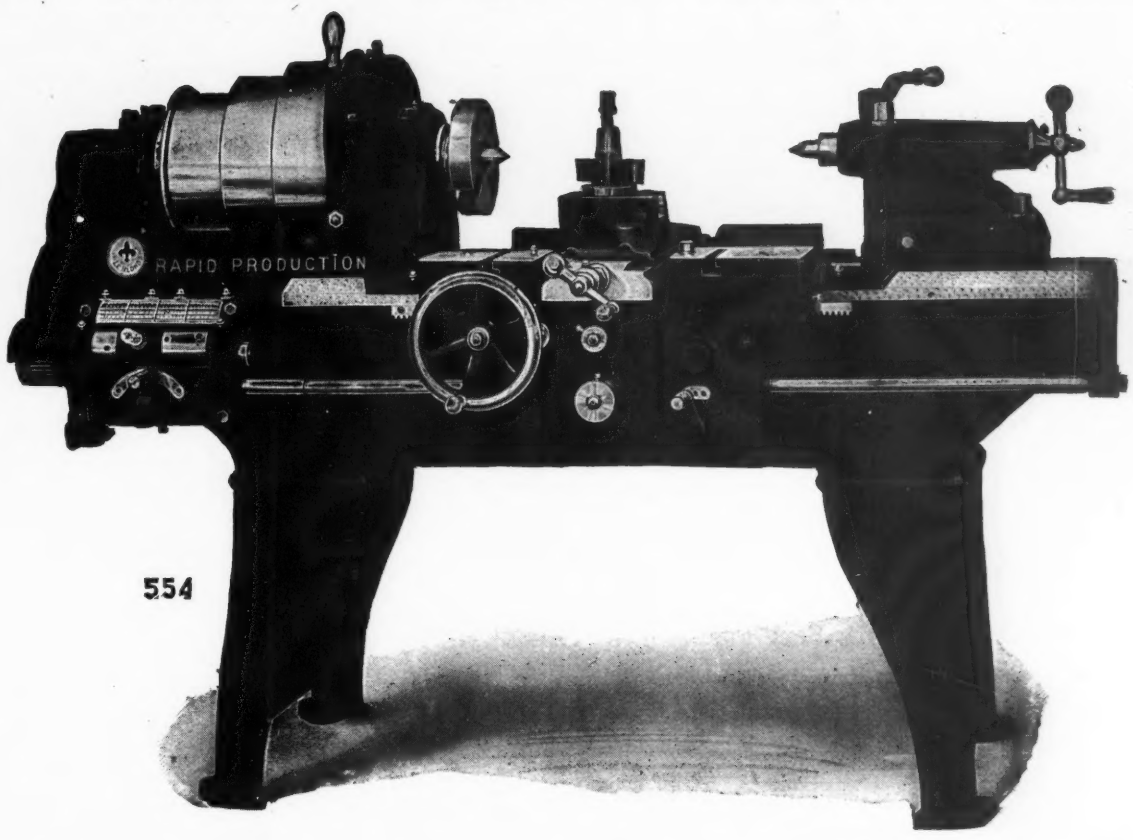
We can make prompt shipment of a considerable number of lathes.

H-S-G TRADE MARK

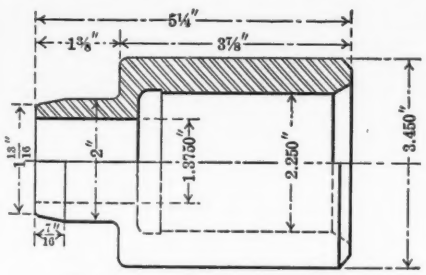
THE HOUSTON, STANWOOD & GAMBLE CO.

CINCINNATI, U. S. A.

SPEEDING UP—in the Reo Shops with "The LeBlond Rapid Production Lathe"

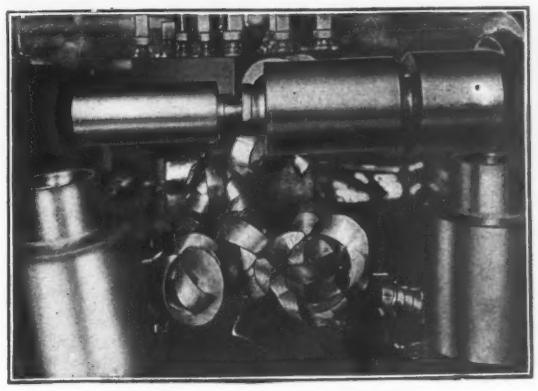


This is the second operation on drive shaft universals for the Reo automobile. The shafts are bored and reamed before they are delivered to the lathe. They are chucked from the bore by an expanding air chuck and the tail spindle brought up to absorb the thrust of the cut. The 1½ inch reduction, ¾ on the side, is taken at a single cut consuming just thirty-one seconds; the turret tool post indexed, bringing in a set of tools for squaring out the shoulder, cutting to length and forming all bevels. The turret is again indexed, bringing up a round nose turning tool which reduces the rest of the body to grinding size. Measuring is entirely eliminated. Cross stops size the diameter and longitudinal stops gauge the length.



Made from .15 Carbon O. H. Steel
FINISHED EXTERNALLY COMPLETE IN TWO MINUTES

Write for catalog describing this machine in detail.



DETAIL VIEW OF OPERATION

We believe this production is unusual. It is the direct result of LeBlond Heavy Duty Features worked out to the last degree of simplicity.

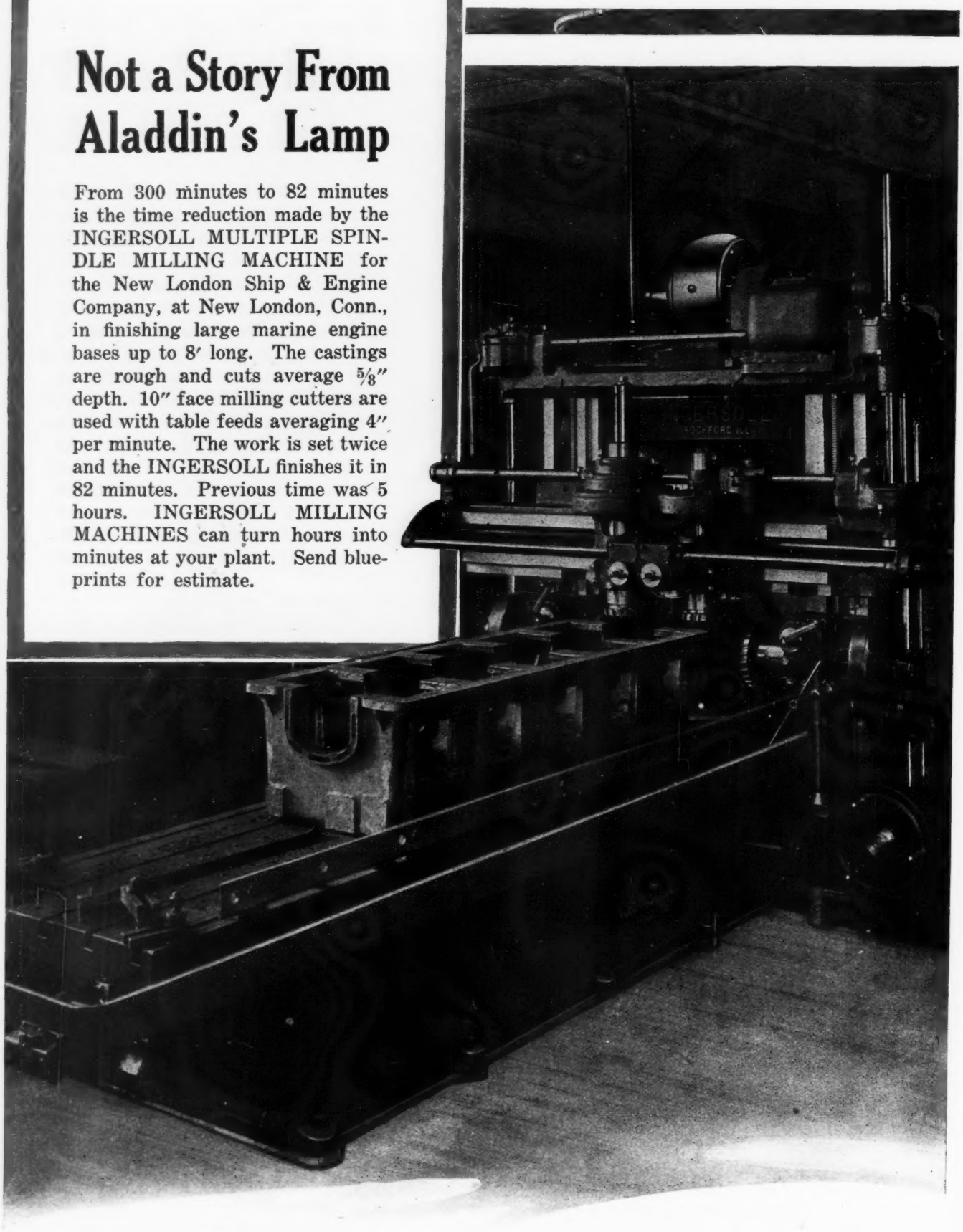
THE R. K. LEBLOND MACHINE TOOL COMPANY

CINCINNATI, OHIO, U. S. A.

DOMESTIC AGENTS: Niles-Bement-Pond Co., Birmingham, Ala.; Boston, Mass.; Chicago, Ill.; New York, N. Y.; Philadelphia, Pa.; Pittsburgh, Pa.; St. Louis, Mo. Eccles & Smith Co., Los Angeles, Cal.; Portland, Ore.; San Francisco, Cal. Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo. Cleveland Tool & Supply Co., Cleveland, O. J. L. Osgood, Buffalo, N. Y. The E. A. Kinsey Co., Cincinnati, O.; Indianapolis, Ind. Rumley Wachs Mchy. Co., Chicago, Ill. F. E. Satterlee Co., Minneapolis, Minn. Oliver H. Van Horn, New Orleans, La. Peninsular Mchy. Co., Detroit, Mich.
FOREIGN AGENTS: Henri Benedictus, Antwerp, Belgium. Benson Brothers, Melbourne, Australia; Sydney, Australia. J. F. Berndes & Co., Havana, Cuba. C. W. Burton, Griffiths & Co., London, England. A. R. Williams Mchy. Co., Ltd., Toronto, Ont.; Montreal, Que.; Winnipeg, Man.; St. Johns, N. B. Alfred Herbert, Ltd.; Milan, Italy. J. Lambercier & Cie, Geneva, Switzerland. Schuchardt & Schutte, Copenhagen, Denmark; Berlin, Germany; Stockholm, Sweden; Vienna, Austria; Budapest, Hungary; Prague, Austria. Van Rietschoten & Houwens, Rotterdam, Netherlands.

Not a Story From Aladdin's Lamp

From 300 minutes to 82 minutes is the time reduction made by the INGERSOLL MULTIPLE SPINDLE MILLING MACHINE for the New London Ship & Engine Company, at New London, Conn., in finishing large marine engine bases up to 8′ long. The castings are rough and cuts average ⅝″ depth. 10″ face milling cutters are used with table feeds averaging 4″ per minute. The work is set twice and the INGERSOLL finishes it in 82 minutes. Previous time was 5 hours. INGERSOLL MILLING MACHINES can turn hours into minutes at your plant. Send blueprints for estimate.

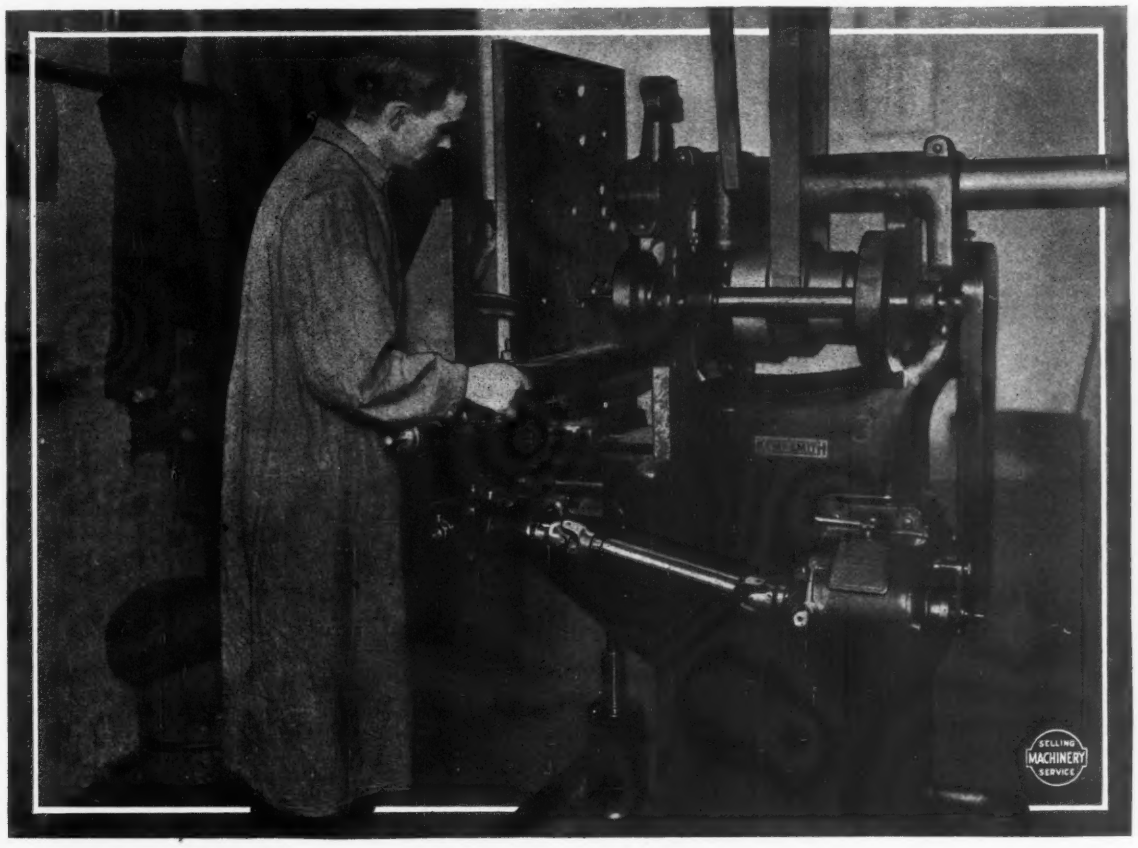


We will send one of our engineers, without expense or obligation, if you desire.

THE INGERSOLL MILLING MACHINE CO.

MILLING MACHINES EXCLUSIVELY

Main Office and Works: ROCKFORD, ILLINOIS, U. S. A.



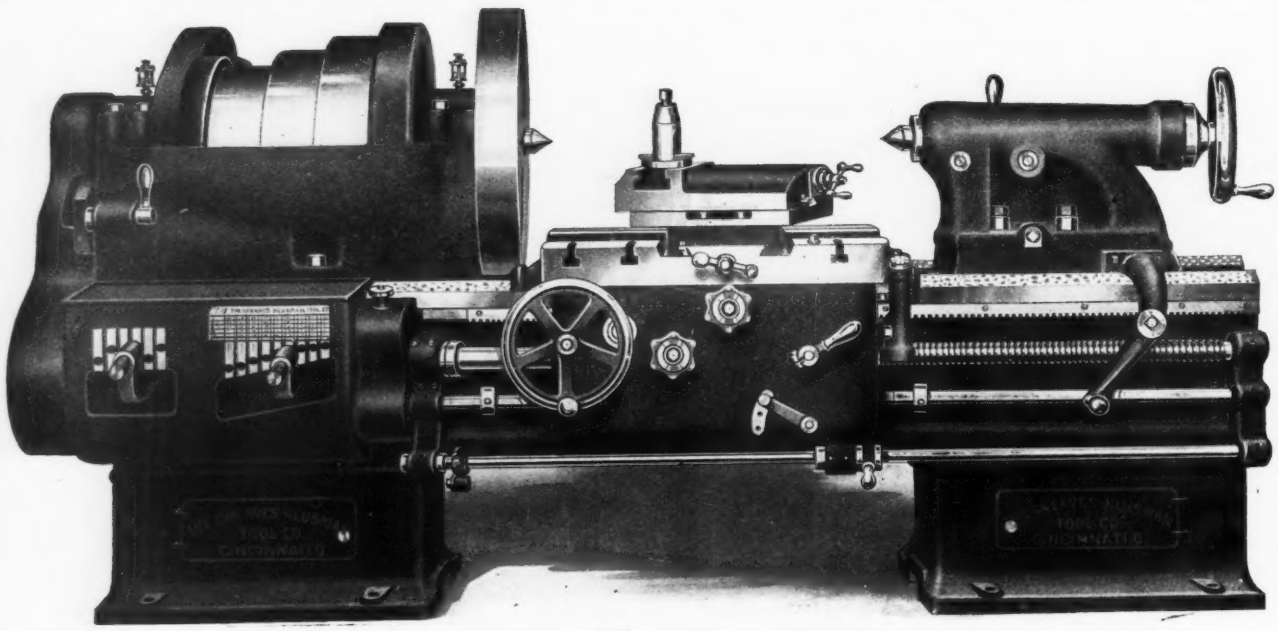
Ask Any Jig Maker About the KEMPSMITH

Find the tool room with a Kempsmith Milling Machine and ask any of the tool makers how they like it. The answer will be the same everywhere—it is a splendid machine for the work and every man who has had occasion to use it will say so.

The Deyo-Macey Engine Co., Binghamton, N. Y., does a lot of fine jig making; the photograph shows a typical top plate having 40 holes of different size and center distances. The man who runs the Kempsmith says this machine is a favorite of his because he knows the work is *right* when it is done; because it is *easily* controlled; because it has never given trouble of any kind in over three years' service.

Can you use a milling machine with these qualities?

KEMPSMITH MILWAUKEE, U.S.A.



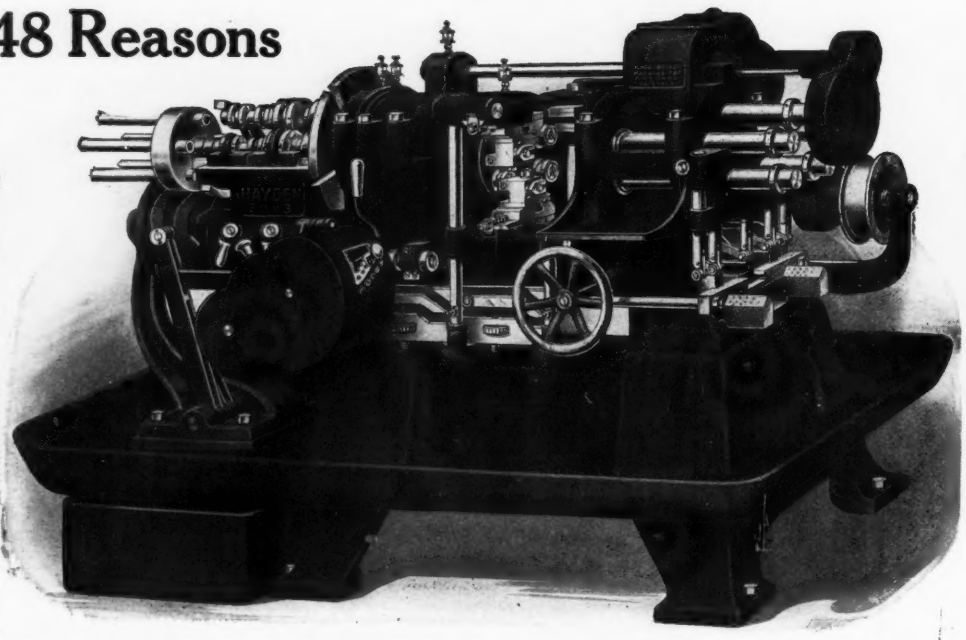
A Better Lathe

Most lathes are just lathes—good enough for some work doubtless—but a G-K lathe is something out of the ordinary. It has capacity for *all* kinds of work. Doesn't it look as though it could do a *real* day's work? There's power and stamina behind those sturdy lines; there's flexibility and efficiency in the quick change gear mechanisms.

Our booklet "G-K Betterments" tells all about it. Shall we mail your copy?

THE GREAVES-KLUSMAN TOOL CO., Cincinnati, Ohio

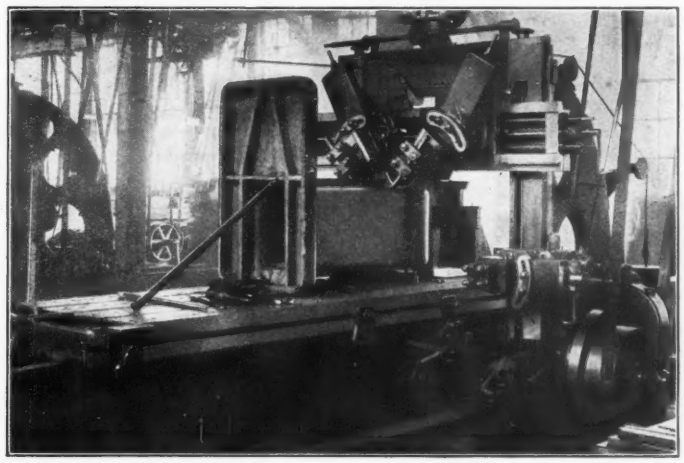
There are 48 Reasons Why it Should Be a Hayden



Good sound reasons, too—reasons that carry weight with practical men when the purchase of an automatic screw machine is contemplated. They are features that make the Hayden Automatic a distinctive machine for profitable production—such features as duplicate control, permitting operation from either side of the machine; 16 changes of spindle speeds and 20 changes of time are available, thereby accommodating a large variety of work; no special cams necessary; friction safety clutch to protect tools in case of accident; plain indexing plates, making reference tables unnecessary. Then there is the advantage of having the five spindles at work simultaneously, that should not be overlooked. Neither should the simplicity of the single belt drive.

Why not write for a catalog now?

CINCINNATI AUTOMATIC MACHINE COMPANY
OAKLEY, CINCINNATI, OHIO

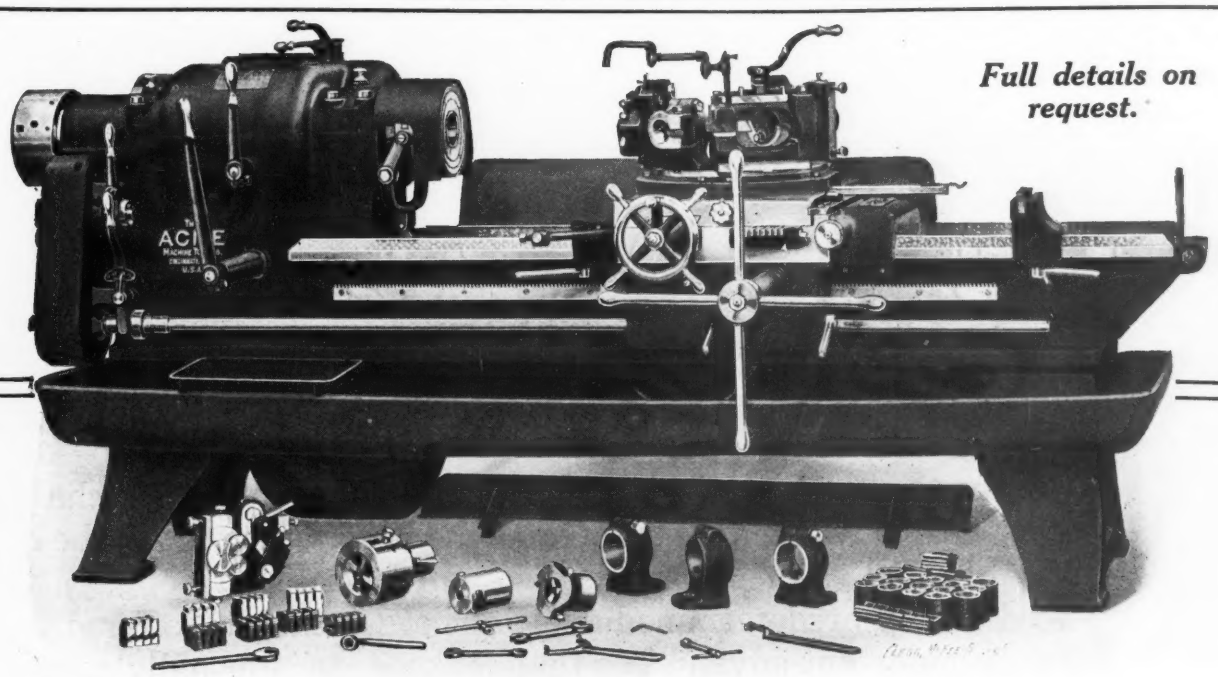


"Heald" Does it the Cincinnati Way, and--

The output and quality of the work prove it a distinctly profitable way. Ask the Heald Machine Company. With heavy grinding machine beds to finish, the problem was to get accurate work and fast production. But with a Cincinnati Planer there was no difficulty in meeting both demands. Strong, rigid and powerful, broad in range and easy to operate, these machines meet exacting requirements and make production records. The Heald people found a "Cincinnati" a paying proposition, and you won't demand any more of a machine than they do. The "Cincinnati" will make good on your work—increase output and lower costs—and we can prove it. Give us the opportunity.

CINCINNATI PLANER CO., Cincinnati, O., U. S. A.

Full details on request.

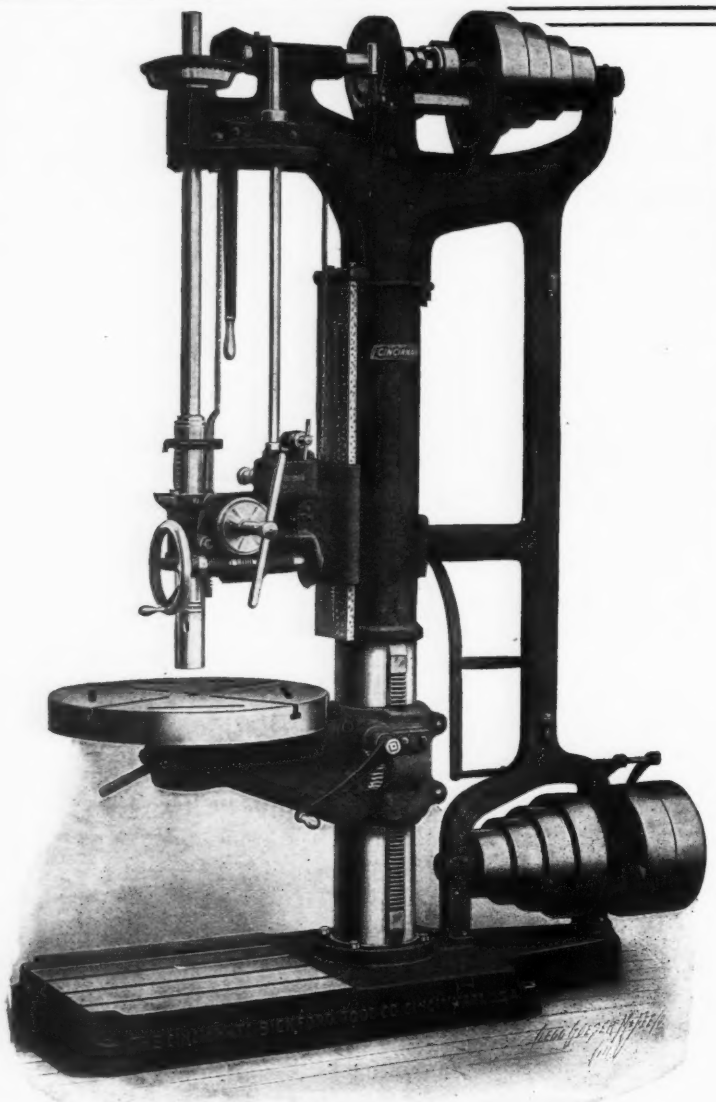


The Cincinnati-Acme Combination Flat Turret Lathe

A machine that gets down to business at 7 A. M. and keeps right on going until 6 P. M. and as long after as you like. Top speed, maximum production all the time. Bar work or chucking, it gives the same good output. Really does the work of two machines, yielding a double profit. Simple tooling quickly set up. Sure producers you should know more about.

The Acme Machine Tool Co., Cincinnati, O.

Manufacturers of Screw Machines and Turret Lathes



Strength—Utility—Productiveness—A Trio of Striking Features in This Unusual Machine

Every line in this "Cincinnati" Heavy-pattern Upright Drilling Machine bespeaks strength and service—and years of hard use bear it out. The service a man gets from a "Cincinnati" Machine is not only efficient—it is continuous and permanent.

The base is heavy and well proportioned. The column, large, accurately ground and stiffly braced, gives a long, solid bearing for the table. By careful counterbalancing, the head is quickly positioned, and once in place, can be securely clamped. The spindle is made of high-carbon steel, has eight speeds, a ball thrust bearing and a quick advance and return. Smoothly driven by accurately planed gears.

Six positive feeds are instantly available through a quick-change gear-box conveniently mounted on the head. All gears in the box are of steel. An automatic trip can be set to disengage the feed at any predetermined depth. The "Cincinnati" offers many other important advantages that make it an unusually productive machine. Circular U-4 describes them.

THE CINCINNATI

The Cincinnati Bickford Tool Co.

Oakley, Cincinnati, Ohio, U. S. A.

U-522

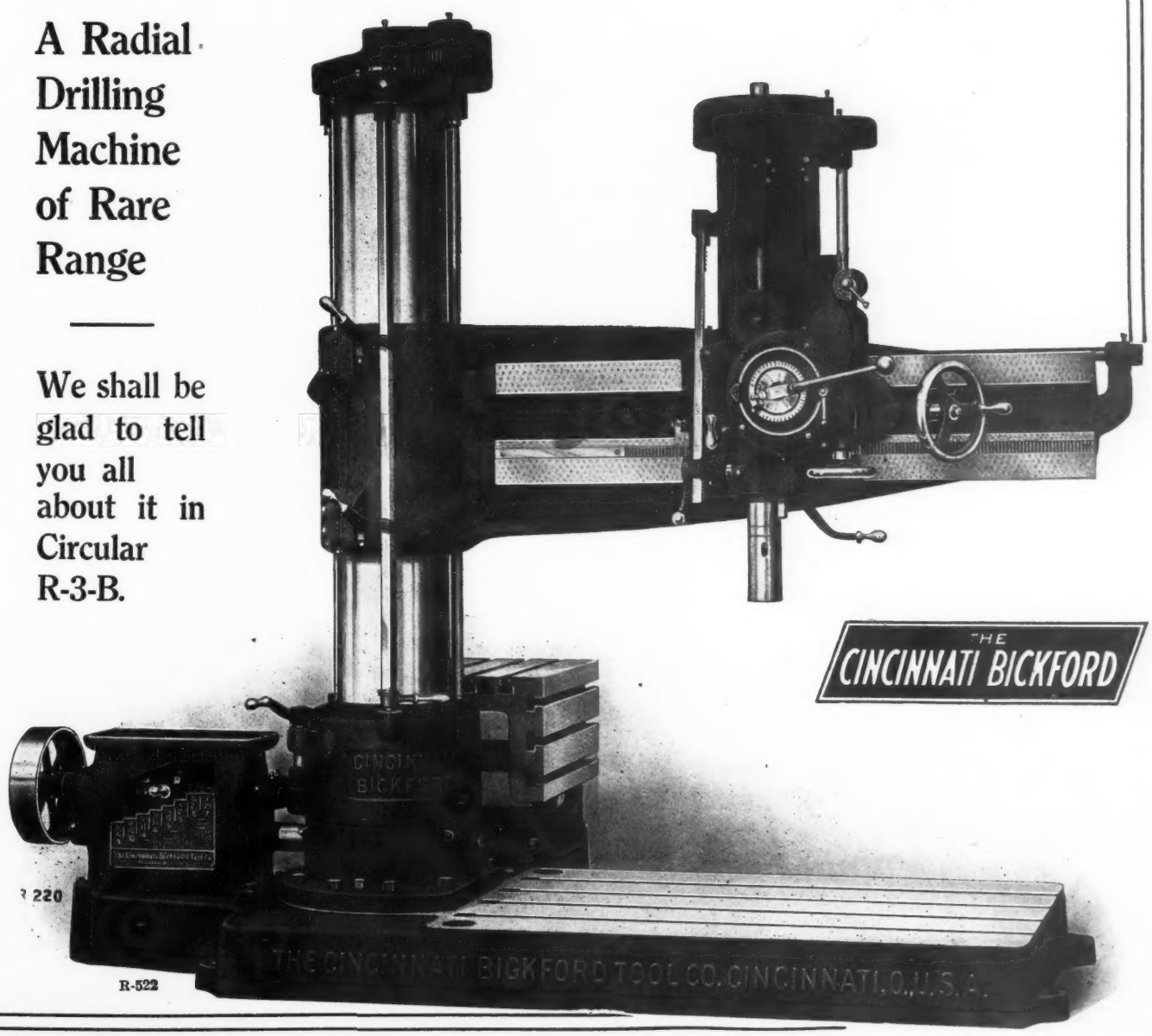
AN enumeration of a few of the features of "Cincinnati Bickford" Radial Drilling Machines will furnish good reasons for their wide range of usefulness and unbeatable standard of production. The general design is uncommonly strong. Although stiff and massive, the column swings with perfect ease, making it simple to position for drilling.

A feature of prime importance is the head. Solid and well balanced, it requires no auxiliary bearing back of the arm. It is fully enclosed, protecting both the mechanism and the operator. The interior, however, is readily accessible. The design of the depth gauge is particularly noteworthy. Simple, accurate and conveniently located, it possesses advantages found in no other device of similar character.

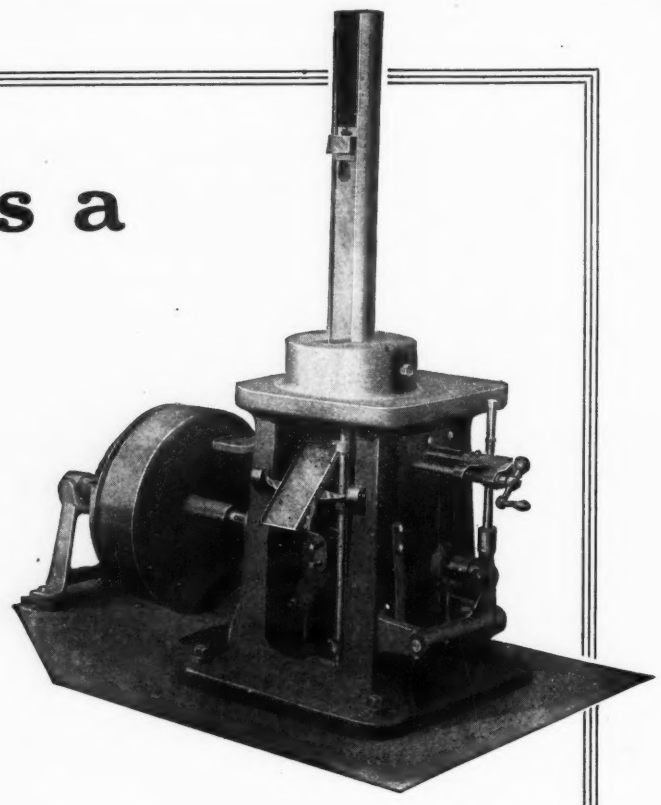
"Cincinnati Bickford" Regular Plain Radial Drills are built in 4-, 5- and 6-foot sizes. For economy, fast production and long service, they are easily the most satisfactory radials on the market.

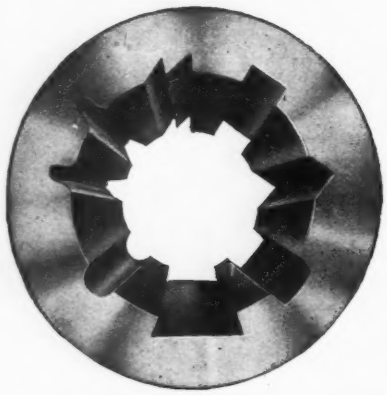
A Radial Drilling Machine of Rare Range

We shall be glad to tell you all about it in Circular R-3-B.



Where There's a "GIANT" There are No Keyseating Problems

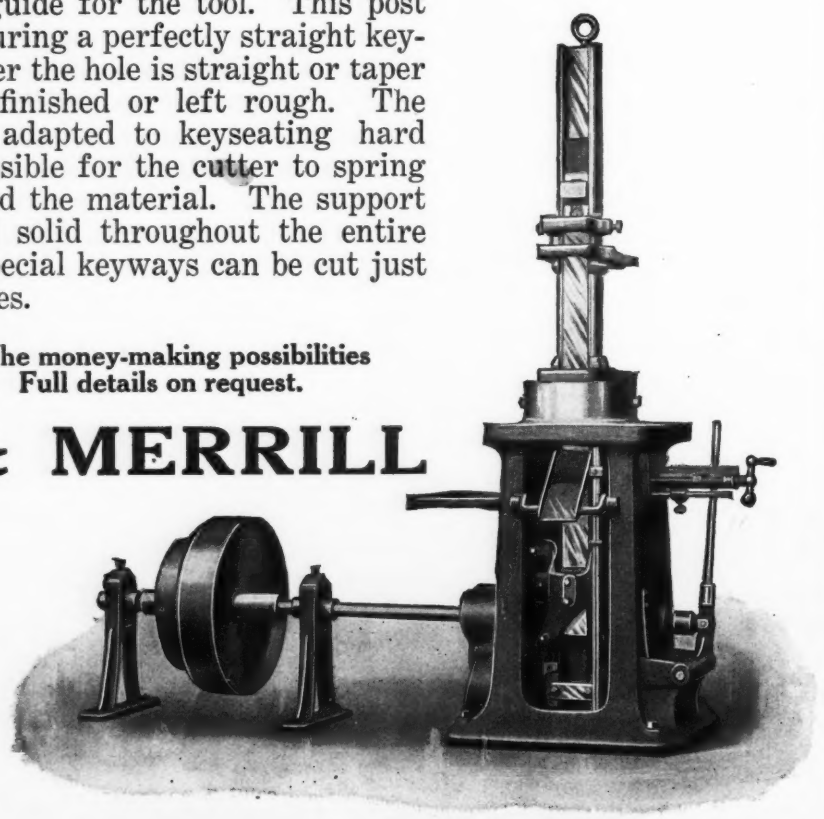




With this machine in a shop a host of costly, vexatious keyseating troubles disappear. No more crooked, irregular keyseats, no rough and ragged cuts. Instead, keyseats are clean-cut and true, and are finished in a fraction of the time required by old methods.

The GIANT cuts keyways of all kinds without the necessity of facing hubs to secure a true bearing.

A distinctive feature is the grooved post which holds the work and forms a guide for the tool. This post solves the problem of securing a perfectly straight keyway regardless of whether the hole is straight or taper or whether the hub is finished or left rough. The **GIANT** is admirably adapted to keyseating hard steel hubs as it is impossible for the cutter to spring back no matter how hard the material. The support for the tool is stiff and solid throughout the entire length of the stroke. Special keyways can be cut just as easily as standard types.



You should investigate the money-making possibilities of the GIANT. Full details on request.

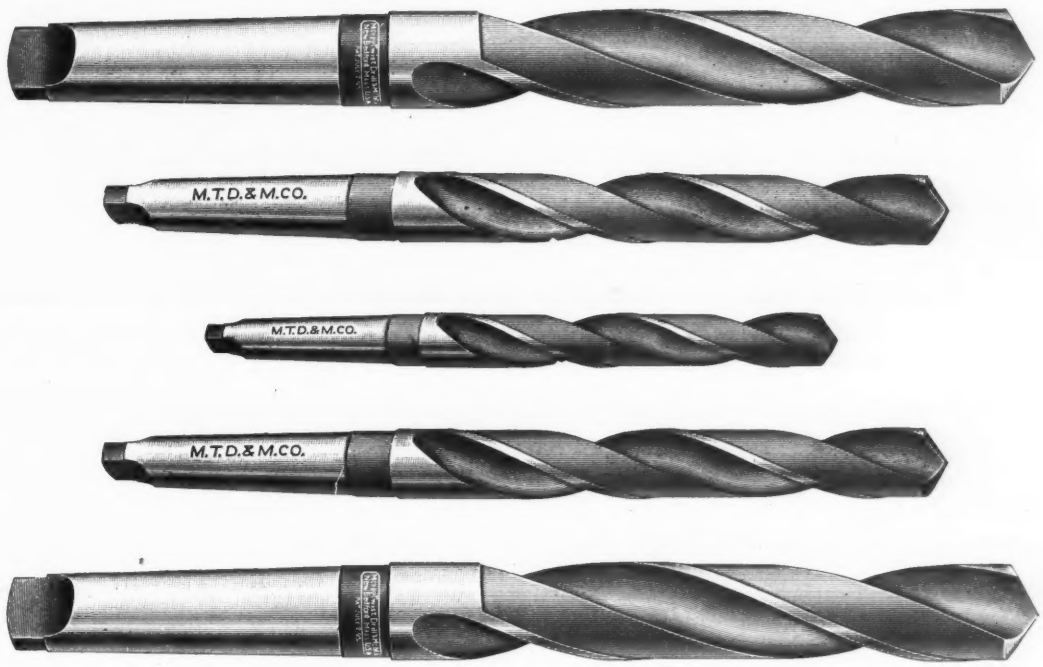
MITTS & MERRILL

843 Water St.

SAGINAW MICHIGAN

FOREIGN AGENTS: C. W. Burton, Griffiths & Co., London, England. Heinrich Dreyer, Berlin, Germany; Austria and Russia. Leon Chapuis, Paris, France; Belgium and Switzerland. V. Lowener, Stockholm, Sweden. Post Van Der Burg & Co., Rotterdam, Holland.

ARMOR



Worn as a protection to fighting men is again in use, but do you suppose the efficacy of the present devices was tested for the first time on the firing-line?

Why then should you fill your shop with tools bought by price alone or at the instance of some adviser?

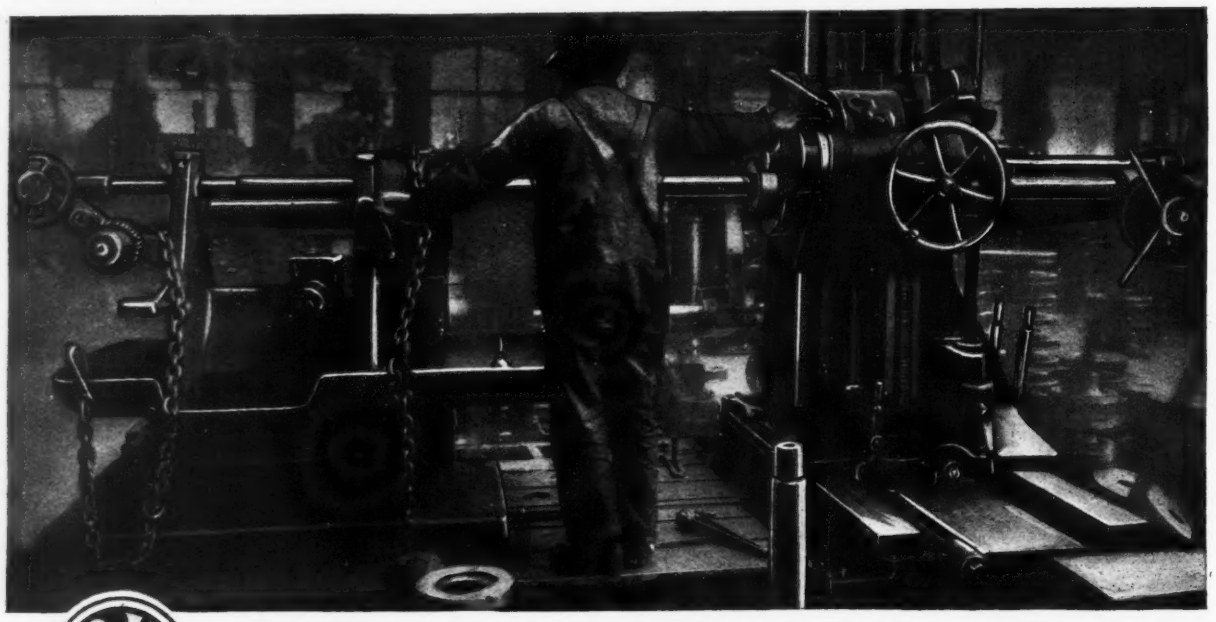
If you wait to test your armor on the battlefield its quality will be proved but you may not know the result.

Make the tests yourself and your next requisitions will specify "Morse" Drills.

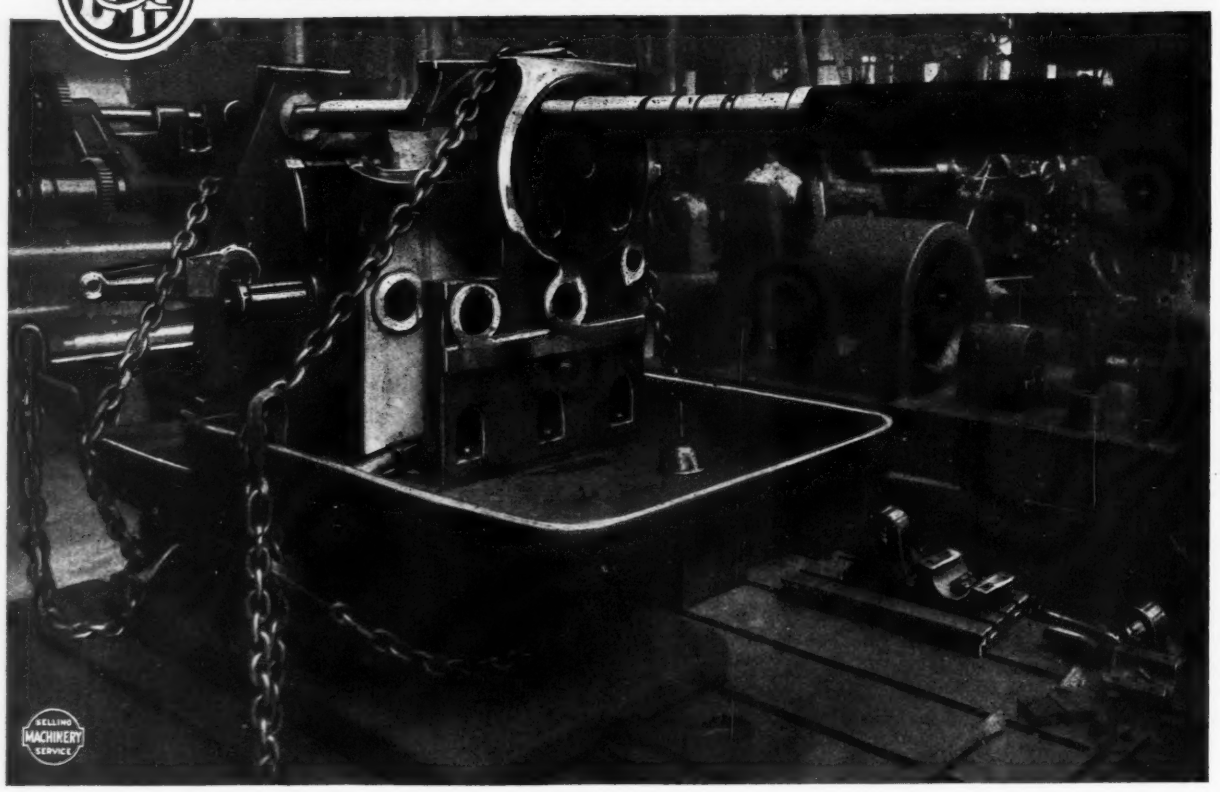
"MORSE" Means Service Every Time

Morse Twist Drill & Machine Co.

New Bedford **Massachusetts**



D&H FLOOR BORING MACHINE



A Necessity in Machine Building

DETRICK & HARVEY MACHINE COMPANY
BALTIMORE
MARYLAND U. S. A.

You may have any number of boring machines that can take *parts* of your machine for milling, boring and facing operations; but unless you have a good boring machine to take your *whole* machine in a unit you will find yourself "up against it" one of these days. Many aligning and transferring operations *must* be performed after the machine is practically done.

The National-Acme Manufacturing Company, Windsor, Vermont, has used a Detrick & Harvey Floor Boring Machine for seven or eight years for boring operations that must be done on the larger parts of the machine or on the assembled machine, such as boring through the spindle holes, as shown in the accompanying photograph. Operations performed in this manner are sure to be in line.

If you are performing work of this kind you can save money by doing it *right*—on a D & H Floor Boring Machine. Let us show you.

A PROOF OF SINCERITY

We speak in behalf of all manufacturers who have adopted a course identical with ours in dedicating every facility to the service of the old-time customer.

◆ ◆ ◆

In spite of this precaution we have been unable to maintain our prompt delivery service of former days. Perhaps you have taken this to be an indication of insincerity on our part, or a token of our lack of appreciation of your difficulties? Such is far from the case.

◆ ◆ ◆

We understand full well how intense is your need for tools and we are pitting every ounce of our production against the incoming flood of your demand—we are sincere in our desire to serve you—if we were not, we could long ago have accepted a temporary but extraordinarily profitable type of business as a substitute for yours. But we didn't.

◆ ◆ ◆

Shouldn't the mere fact that we chose to forego this extra profit be proof sufficient that we are genuine in our desire to serve you and that we are now doing our level best to supply you at the time and in the quantity you want?

THE
CLEVELAND TWIST DRILL
COMPANY

CLEVELAND

NEW YORK CHICAGO

OILING

THE DRIVING SHAFTS are oiled by the gravity system from oil reservoirs. The oil is strained through felt pads and fed drop by drop into the bearings where it is continuously circulated by endless spiral oil grooves turned in the solid bushings.

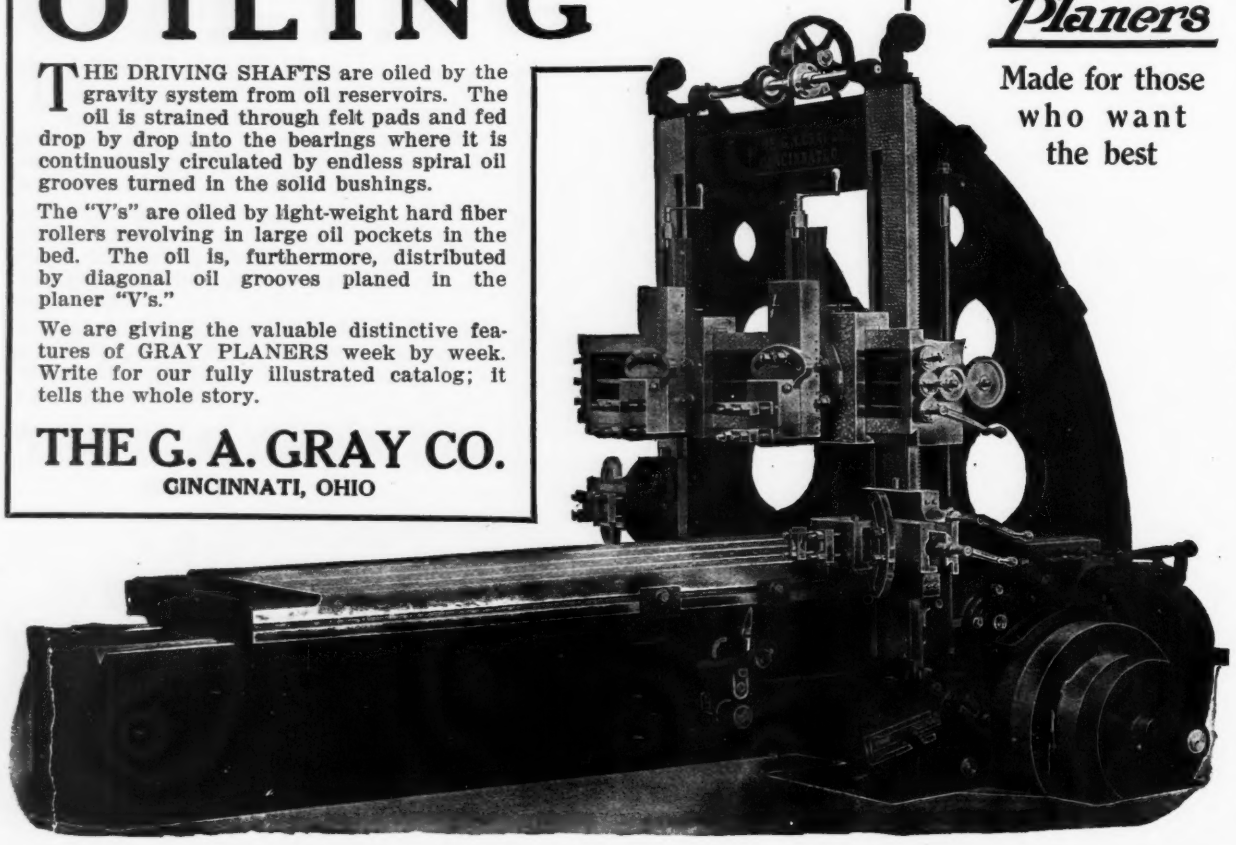
The "V's" are oiled by light-weight hard fiber rollers revolving in large oil pockets in the bed. The oil is, furthermore, distributed by diagonal oil grooves planed in the planer "V's."

We are giving the valuable distinctive features of GRAY PLANERS week by week. Write for our fully illustrated catalog; it tells the whole story.

THE G. A. GRAY CO.
CINCINNATI, OHIO

Gray Planers

Made for those who want the best



Rigid and Accurate
The "Cleveland" Open Side Planers

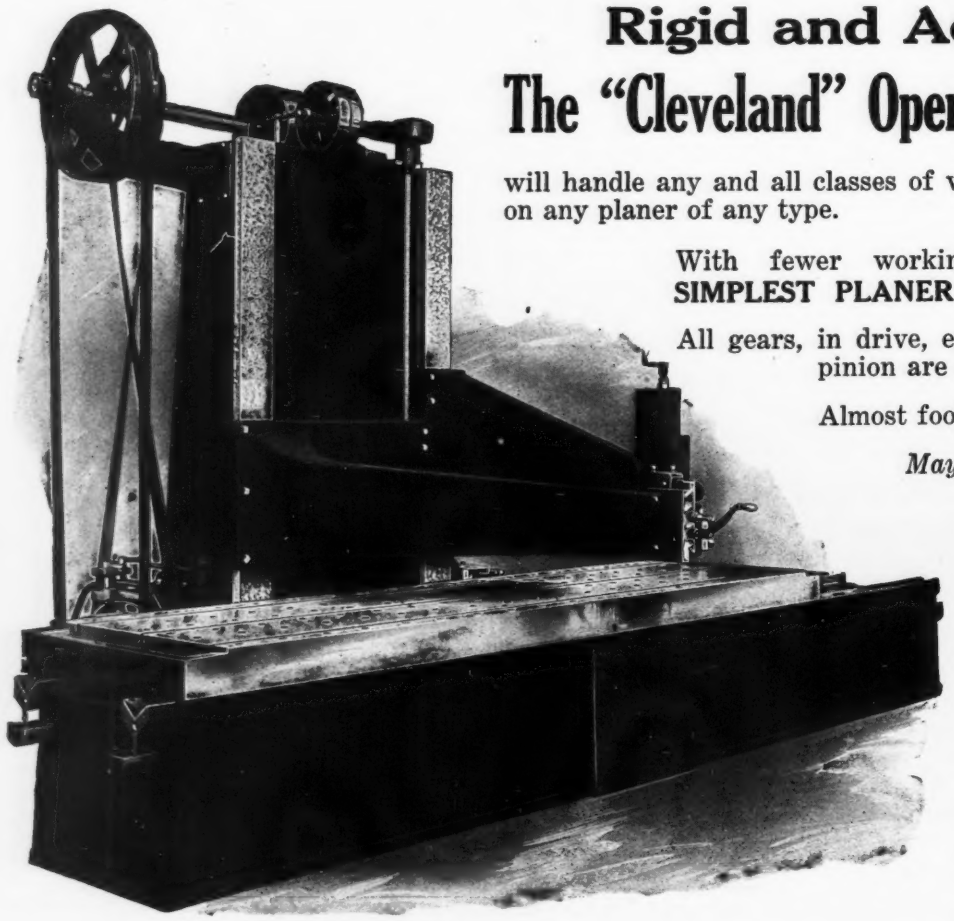
will handle any and all classes of work equal to that done on any planer of any type.

With fewer working parts, it is the **SIMPLEST PLANER ON THE MARKET.**

All gears, in drive, except bull gear and its pinion are enclosed and run in oil.

Almost fool-proof.

May we send you a catalog?



CLEVELAND PLANER WORKS

JAMES G. DORNBIRER
GEO. W. FORD

3150-3152 Superior Ave., CLEVELAND, OHIO, U. S. A.

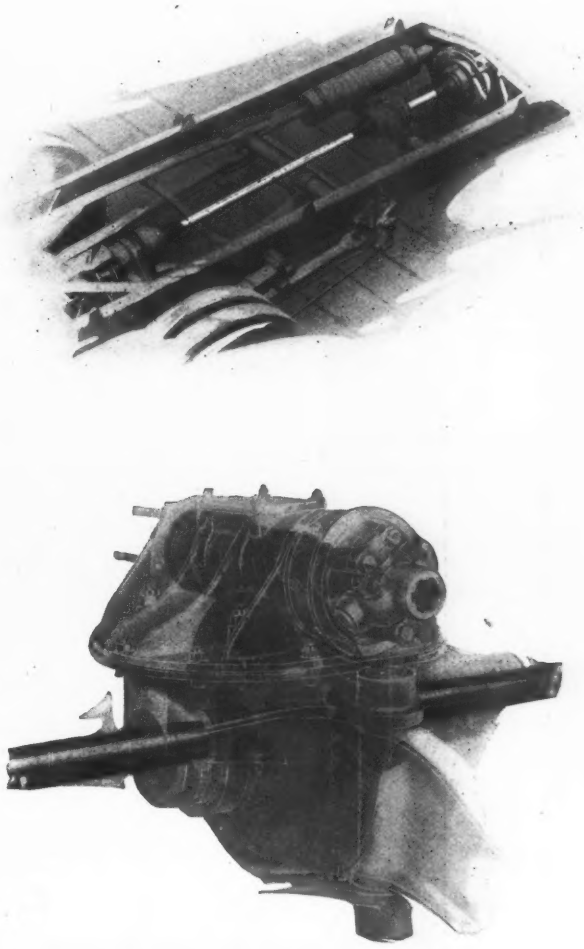
The Story of the Motor Truck and the *Lo-swing* Lathe

No motor truck manufacturing equipment is complete without its LO-SWING Lathe department. We can cite many motor truck factories to prove it—where the LO-SWING is making big savings turning special rods and shafts. Here are two motor truck parts on which the LO-SWING outclasses all other machines.

The propeller shaft, which transmits the power from the engine to the rear axle, is made from extremely hard, tough steel. It is difficult to turn, and more difficult to finish accurately. It is, therefore, a LO-SWING job.

The rear axle live driving shaft is another tough piece of steel, built to withstand great torsional strains. There are several shoulders and tapers and all are turned simultaneously on the LO-SWING. If you build motor trucks, or any product with shafts having several diameters, you must have the LO-SWING Lathe if you are going to stay in the game. We'll be glad to figure production estimates on your work if you'll send blueprints.

"Get the Multiple Turning Habit."



Photos through courtesy Pierce-Arrow Motor Car Co., users of three LO-SWING Lathes

Fitchburg Machine Works
FITCHBURG, MASS.

SOLD DIRECT BY OUR REPRESENTATIVES IN THE UNITED STATES AND CANADA

FOREIGN AGENTS: Allied Machinery Co. of America, 3 Rue Paul Dubois, Paris, for France, Switzerland and Italy. Buck & Hickman Ltd., London, Birmingham, Manchester, Glasgow. The F. W. Horne Co., Tokio, Japan.

Write us for the LO-SWING booklet anyhow.

NICHOLSON

BEST SERVICE

CAN be secured only by the use of tools of proven quality.

The superior quality of NICHOLSON FILES has been known to file users for more than half a century.

This superiority has been brought about by the use of highest grade materials, exclusive methods and an intimate knowledge of the requirements of file users.

Send for our catalog and booklet "File Filosophy". They will interest you.

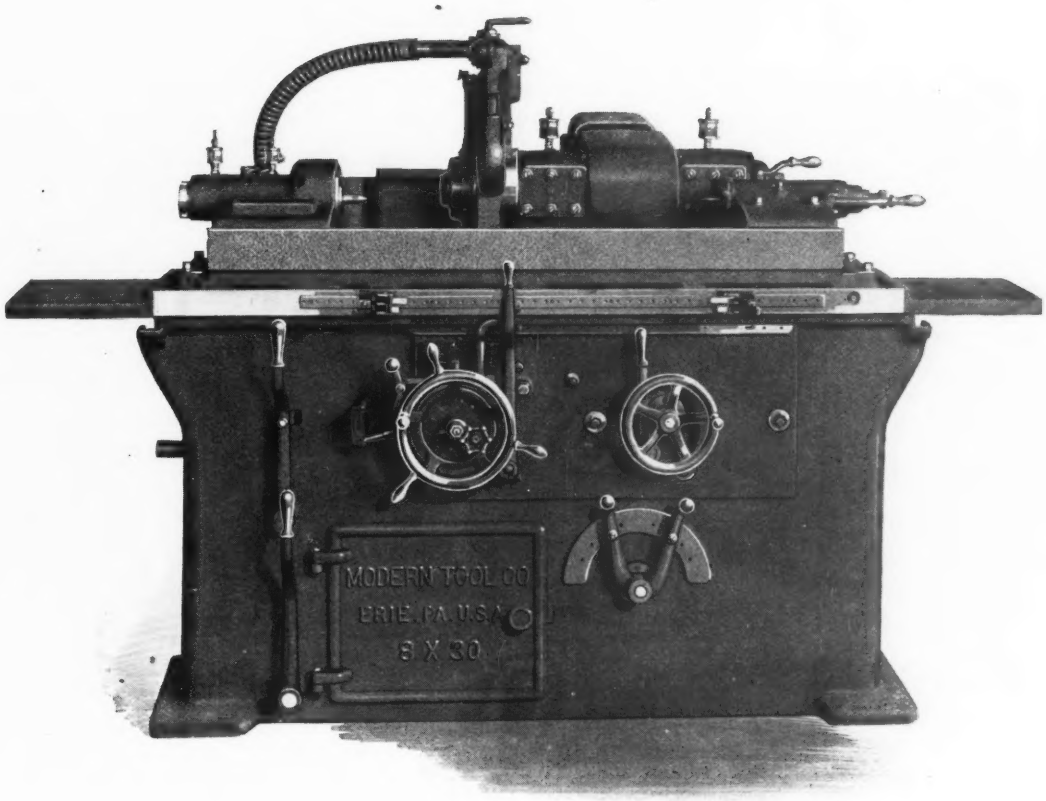
BY INVITATION MEMBER OF

NEW YORK U.S.A.

NICHOLSON FILE COMPANY
PROVIDENCE R. I., U. S. A.

NICHOLSON U.S.A. (TRADE MARK)

MODERN



With your samples and specifications before us we will show you how the "MODERN" Grinding Machines are most economical on your particular work.

FEATURES of MODERN 8″ x 30″ Self-Contained Plain Grinding Machines are economy of floor space, compactness, ease of operation and simplicity of mechanism. All operating levers are concentrated on front of the machine within easy reach the operator. Nothing extends above the wheel stand, all mechanisms are contained within the machine. The table drive is of a simplified type and consists of a single unit contained in the bed of the machine. The Automatic Cross Feed, which is positive in its action, operates at either or both ends of the table reverse, and may be instantly changed to any feed while the machine is in operation. The headstock, a combination of live and dead centers, is entirely belt driven, the driving shaft being contained within bed of machine. This drive, in addition to being powerful, gives an absolutely smooth movement to the work and eliminates any possible chance for chatter. Machine is absolutely self-contained, and has a constant speed drive, power being applied from a lineshaft by a single belt, or by motor connection.

MODERN TOOL COMPANY, Erie, Pa., U. S. A.

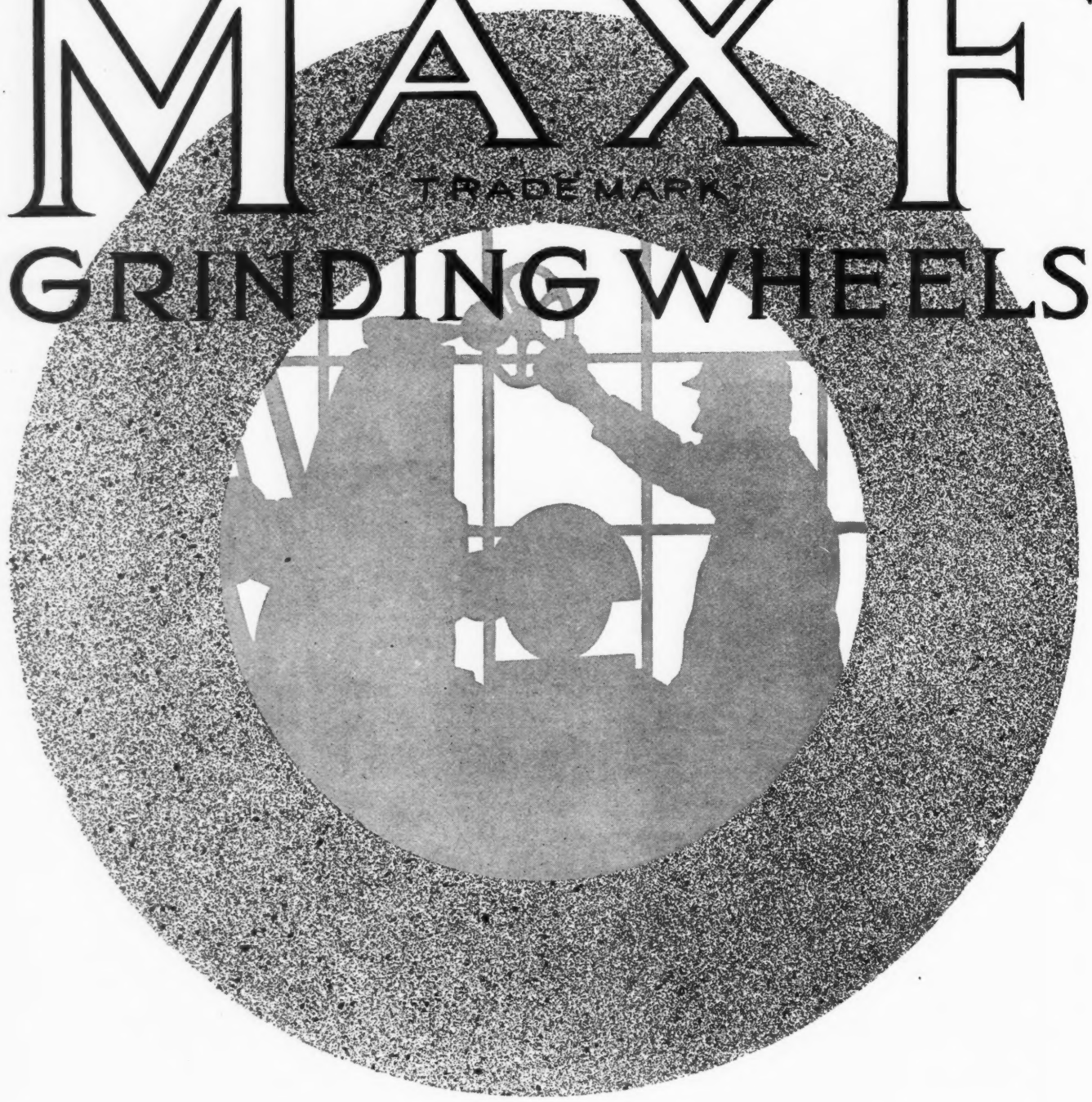
Main Office and Works: Second and State Sts.

Chicago Office 32 N. Clinton St. **New York Office: 50 Church St.**

MAXF

TRADE MARK

GRINDING WHEELS



Maximum Efficiency is the Big Idea back of **"MaxF"** Grinding Wheels—thought out, worked out, tested and proved. Results—better grinding wheels for all classes of work, lower costs because of increased efficiency, and the elimination of grinding troubles due to the use of unsatisfactory wheels.

"MaxF" Wheels are a specialized product, manufactured in a plant fitted throughout with up-to-date equipment. They embody a thorough knowledge of modern grinding requirements, and they are made in sizes, types and grades to meet all demands.

If **"MaxF"** Wheels are new to you, give them a trial. Our engineers will consult with you at any time. We will take the responsibility of selecting the right **"MaxF"** for your work. Just tell us what you grind.

SPRINGFIELD GRINDING COMPANY

Factory and Sales Dept., CHESTER, MASS.

For Those Un-get-at-able Places—

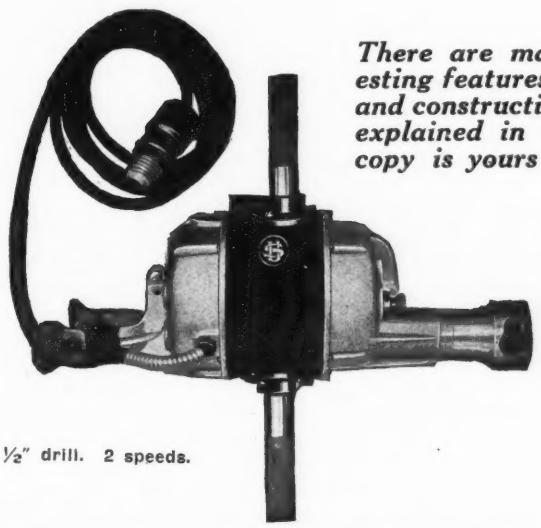
Made in two sizes.
3/8"—1/2".

Those inaccessible corners where it is necessary to drill or grind—a U. S. "Portable" is indispensable. They are big time and money savers because

United States Portable Electric Tools

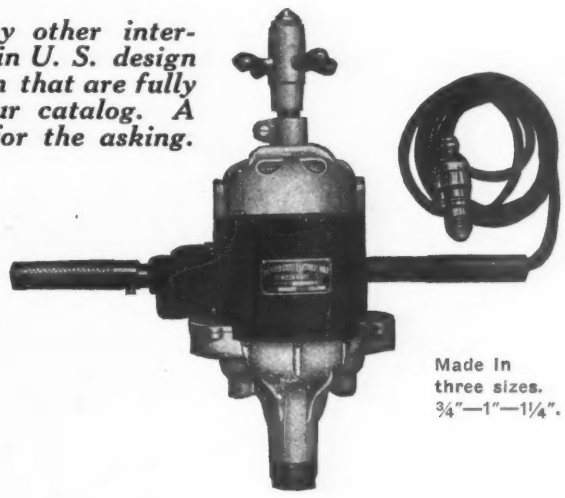
often eliminate the necessity of dismantling machinery or equipment to make changes and repairs. They are compact, light in weight, and can be operated at any angle or in any position.

The motors in U. S. "Portables" are like the tools themselves—first grade. They are designed to give the greatest possible horsepower in a small space, thus keeping the tools light and handy, yet very powerful. Motors are air cooled. Ball bearings take the thrust on the chuck spindle. All gears are hardened and run in grease. The tools are under instant control at all times.



½" drill. 2 speeds.

There are many other interesting features in U. S. design and construction that are fully explained in our catalog. A copy is yours for the asking.



Made in three sizes.
¾"—1"—1¼".

THE UNITED STATES ELECTRICAL TOOL CO.

6th Avenue and Mt. Hope Street **CINCINNATI, OHIO, U. S. A.**

STOCK CARRIED IN BRANCHES

New York Office
30 Church Street, New York City

Chicago Office
549 West Washington Boulevard

Boston Office
12 Pearl Street

St. Louis Office
610 Commercial Building

Detroit Office
2425 West Grand Boulevard

Kansas City Office
2541 Tracy Avenue

Philadelphia Office
The Bourse

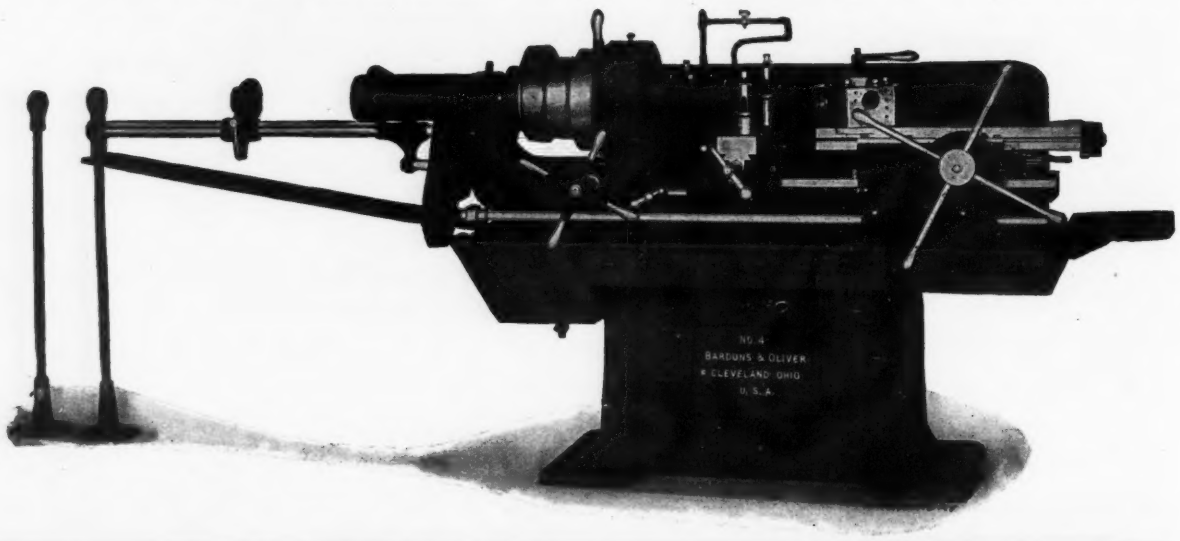
BARDONS & OLIVER TURRET LATHES

Favorites Alike With Operator, Foreman and Shop Manager

B. & O. Turret Lathes are popular all along the line. The operator likes them because they are quickly set up and easy to run. Consistently accurate work is assured and no great exertion is required to meet production demands. They meet with the foreman's approval because of their dependability. He can be sure, when he puts a job on a "Bardons & Oliver," that it can be done right, and on time. No worry, trouble or delay. The reason for the manager's O. K. is obvious; when he has machines that are continuous producers on accurate work, with low operating cost, small maintenance expense, and low depreciation he has a real asset and a sure source of profit.

Would you like to hear the story in detail?

BARDONS & OLIVER, Cleveland, Ohio, U.S.A.



UNION GROUND HOBS

Before ground hobs were introduced, a frequent and justifiable objection to hobbing gears was the inaccurate results obtained, due to distortion in the teeth of the hobs. Union Ground Hobs have removed that objection. These hobs are *ground all over after hardening*. Any inaccuracy that may have developed in hardening is thus removed. We are able to harden Union Hobs to a greater degree of perfection, as we no longer fear the effects of distortion. These hobs turn out accurate, smooth running gears.

Another big feature is that Union Ground Hobs may be set up without reference to any particular tooth, as all are exactly alike. This is a point of economy, as the hob can be moved along successively until the entire length is dull. Our "Book of Information," Edition G, is a complete reference manual on cutting tools. Send for a copy.

Union Twist Drill Co.

Athol, Mass.

Automatic Lathe

The Reed-Prentice Automatic Lathe is designed especially for turning out a great variety of first quality repetition work at record speed.

It is a highly specialized machine and yet so ingeniously simple in its operation that hardly more is required than an attendant to supply the lathe with stock and remove same when finished.

The Skill and Brains are in the Design of the Lathe

Let us know your requirements and we will furnish production estimates and any other data in which you may be interested.

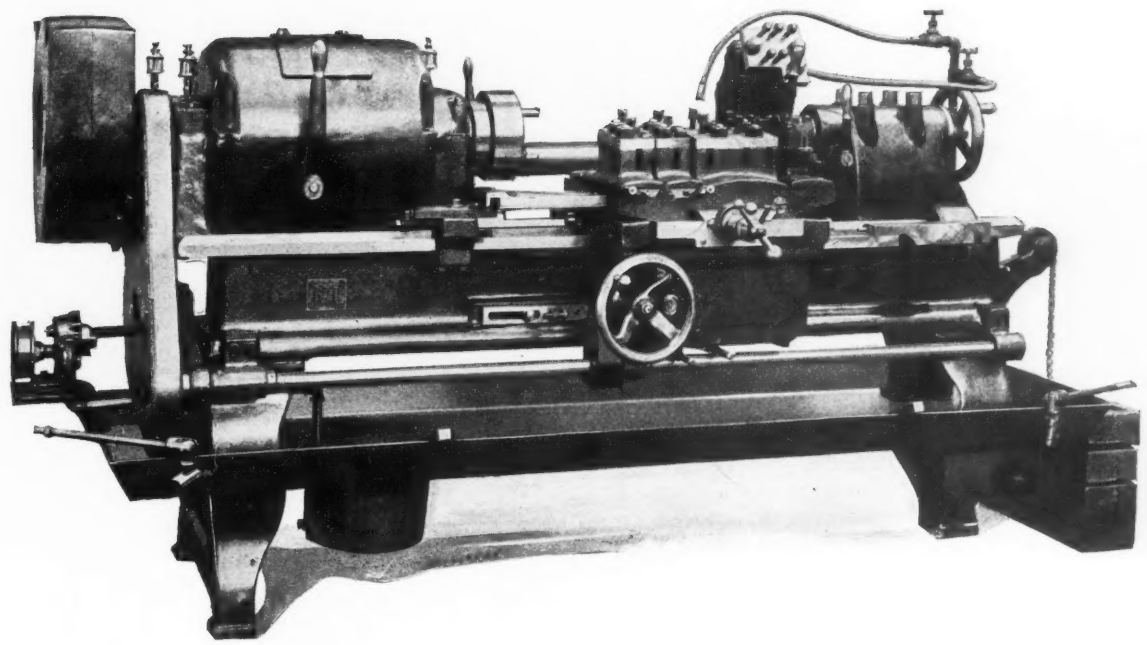
REED-PRENTICE COMPANY,

Selling Agents: Manning, Maxwell & Moore, Inc.,

DETROIT PHILADELPHIA PITTSBURGH
BOSTON BUFFALO SAN FRANCISCO

ALLIED MACHINERY CO. of AMERICA,

for Repetition Work



MACHINING
AUTOMOBILE PARTS

ROUGH AND FINISH TURNING
SHRAPNEL

REPETITION WORK OF EVERY KIND

HIGH SPEED
RECORD PRODUCTION

WORCESTER, MASS., U. S. A.

119 West 40th Street, New York City

Paris, Turin, Zurich, Petrograd

CLEVELAND
NEW HAVEN

CHICAGO
SEATTLE

ST. LOUIS
CINCINNATI

G&E Multiple Gear Cutting

In this operation the teeth are being cut in nine gear blanks at the same time. Blanks are 3½ per cent nickel steel, 3⅜″ diameter, 1¾″ face. There are nineteen 6-8 pitch teeth to each gear. Three arbors hold three gears each; three cutters are employed to do the work. Production is nine completed gears in 30 minutes. This machine, six months in service, is the fourth Gould & Eberhardt Gear Cutter to be installed by the concern that furnishes this data.

G & E Gear Cutters will prove just as profitable in your plant. Facts and Figures on request.

GOULD & EBERHARDT

"HIGH DUTY" SHAPERS
AUTOMATIC GEAR AND RACK CUTTING MACHINERY

ESTABLISHED 1833 NEWARK, N.J. U.S.A.

NOTICE

TO BALL BEARING MANUFACTURERS

THE automatic and other essential features pertaining to the VAN NORMAN BALL-RACE GRINDERS are *fully covered by patents* in the United States and Foreign Countries.

Manufacturers of Ball Bearings and Ball Bearing Machinery are hereby notified that action will be instituted on infringement of the following United States Patents:

Reissued Patent March 16, 1915—No. 13,892
(Original Patent, July 7, 1914—No. 1,102,558)
Patent Issued June 9, 1914 —No. 1,099,218
Patent Issued Sept. 28, 1915—No. 1,155,176
Patent Issued Nov. 2, 1909—No. 938,803

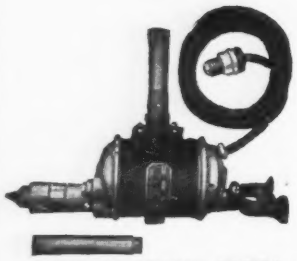
The patented features and improvements in the

Van Norman Automatic Ball-Race Grinders

have resulted in the highest perfection of quality, with reduced cost of production, in this extremely difficult branch of the grinding art.

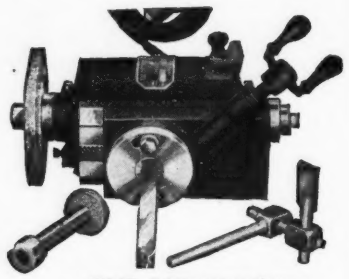
VAN NORMAN MACHINE TOOL CO.
Waltham Avenue
SPRINGFIELD, MASS., U. S. A.

Cut Your Costs—"CINCINNATI ELECTRICS" will do it

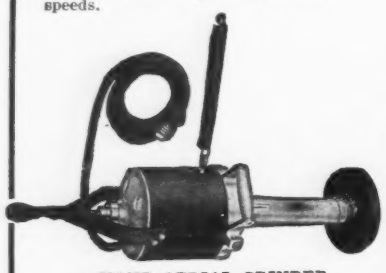


HAND OR BREAST DRILLS
¼", ⅜", ½", ¾" capacities. Weight from 7 pounds up. Ball and thrust bearings. Gears run in grease. Single and two speeds.

HEAVY-DUTY DRILLS AND REAMERS
¾" to 2½" capacities
SCOTCH RADIAL DRILLS
⅞" to 2½" capacities.

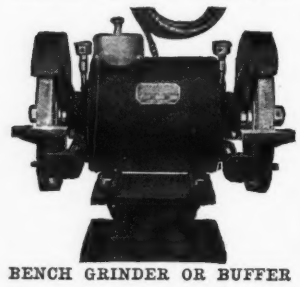


TOOL POST GRINDERS
¼ to 3 H. P. Weight from 16 pounds up. Free hand feed. Bearings adjustable to wear. Horizontal and vertical feeds. Different types for all purposes.



HAND AERIAL GRINDER
For cleaning castings or surface work of any kind. Made in four sizes, ¼ to 2 H. P. Weight from 18 pounds up. Guaranteed for hard usage.

SPECIAL FEATURES
Air Cooled. Ball and Thrust Bearings. All working parts hardened. Overload Allowance. Guaranteed Mechanically and Electrically



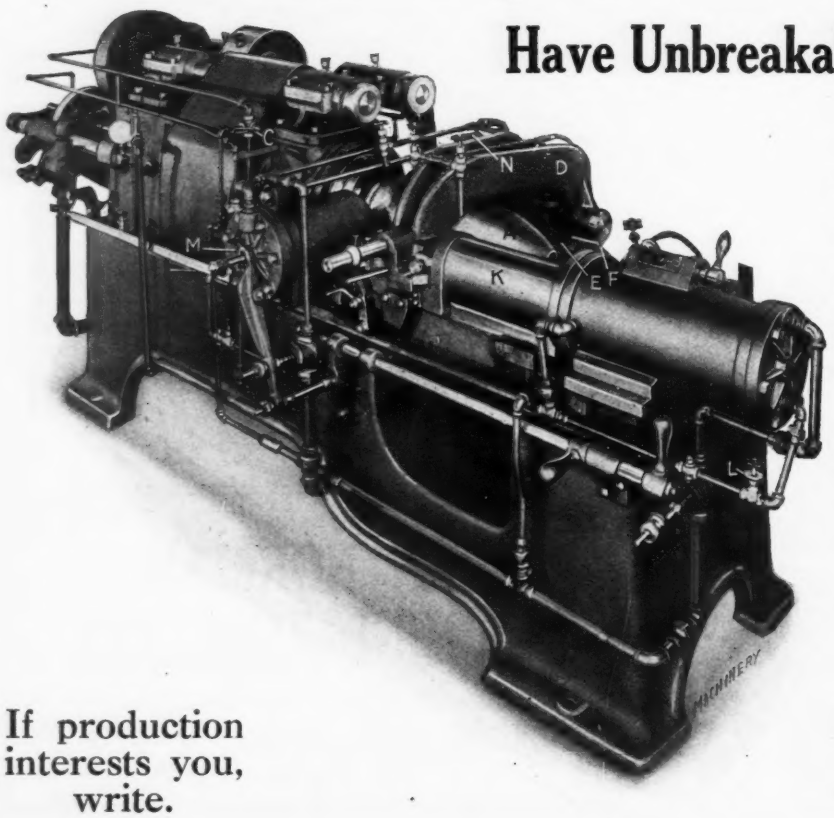
BENCH GRINDER OR BUFFER
Five sizes, ¼ to 3 H. P. Also Pedestal Floor Grinder 1 to 3 H. P. Fully enclosed. Dirt- and dust-proof. Ball bearings.

Cincinnati Electrical Tool Company
CINCINNATI, OHIO

FOREIGN AGENTS: **England:** S. Wolf & Co., London. **Australia:** Parke & Lacey Co., Ltd., Sydney. **Norway:** V. Lowener, Christiania. **Spain:** Sociedad General de Representaciones, Madrid. **France:** R. S. Stokvis & Fils, Paris. **Holland:** R. S. Stokvis & Zonen, Ltd., Rotterdam.
New York Office, 50 Church Street

Warren Hydraulic Lathes

Have Unbreakable Feed Mechanism



That is one reason why this machine at the plant of the Westinghouse Electric Co., operating on eight-inch shells, has roughed out the nose and the outside, bored the fuse hole and cut off the open end in twenty-two minutes.

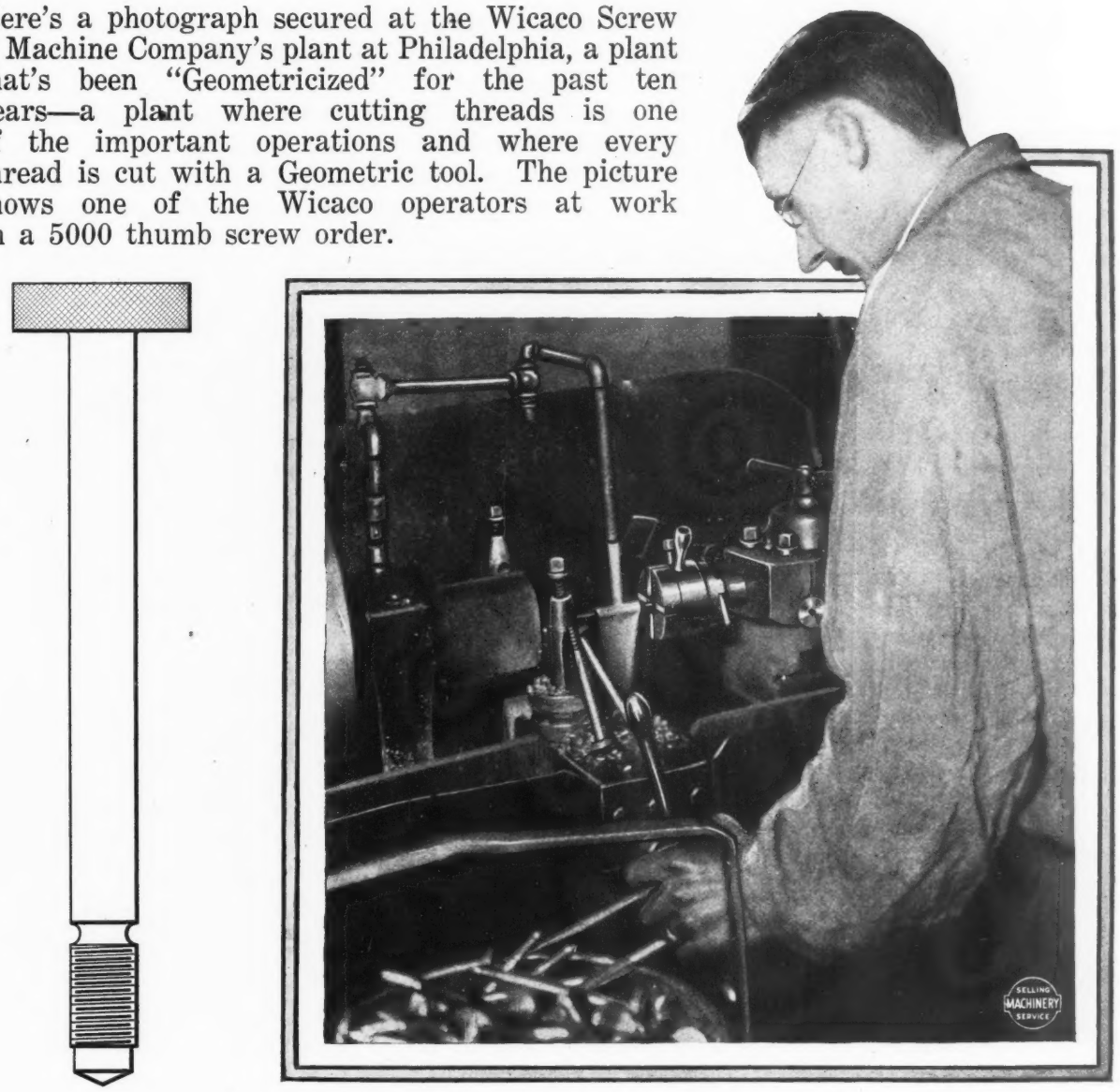
If production interests you, write.

The Lombard Governor Company
Ashland, Mass., U.S.A.

Are You "Geometricized?"

Meaning—are you alive to the possibilities of Geometric Threading?

Here's a photograph secured at the Wicaco Screw & Machine Company's plant at Philadelphia, a plant that's been "Geometricized" for the past ten years—a plant where cutting threads is one of the important operations and where every thread is cut with a Geometric tool. The picture shows one of the Wicaco operators at work on a 5000 thumb screw order.



It takes him just four minutes to machine one of the screws complete. The shortest part of the job is cutting the thread with a Geometric Die Head, and a clean, accurate, finely finished thread it is.

Manufacturing plants of every description, in all parts of the country—government arsenals included—are using Geometric Tools. You will eventually, why not make the start now?

Geometric Die Heads and Geometric Collapsing Taps are cost saving tools—ask us to prove it

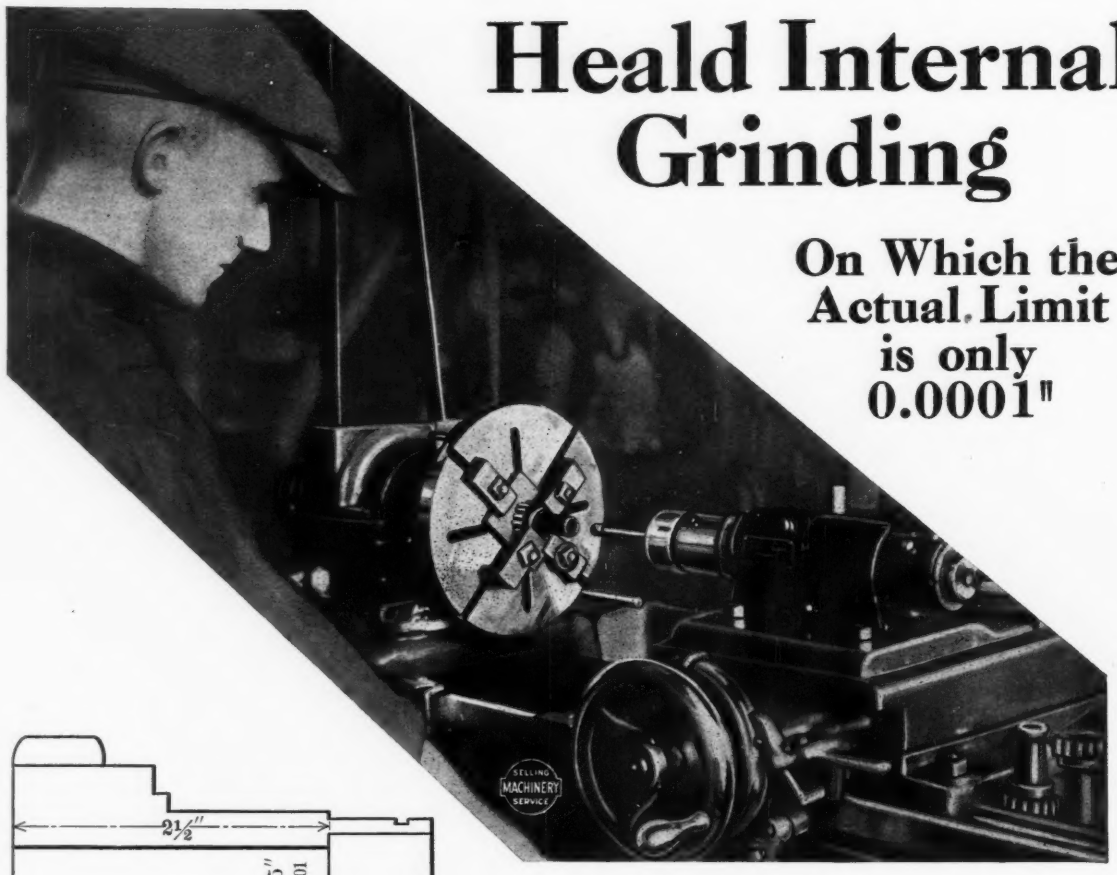
THE GEOMETRIC TOOL COMPANY

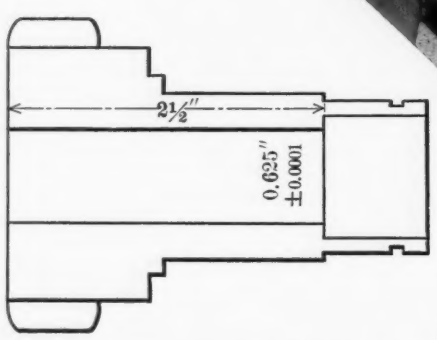
NEW HAVEN, CONN. **Chicago Office: 545 West Washington Boulevard**

REGULAR AGENTS: The Chas. A. Strelinger Co., Detroit, Mich.; Hill, Clarke & Co., Inc., Boston; Vandyck Churchill Co., New York and Philadelphia; Brown & Zortman Machinery Co., Pittsburgh, Pa.; The E. A. Kinsey Co., Cincinnati, O.; Strong, Carlisle & Hammond Co., Cleveland, O. **PACIFIC COAST:** General Machinery & Supply Co., San Francisco, Cal.; Perine Mchy. Co., Inc., Seattle, Wash. **CANADA:** The A. R. Williams Machinery Co., Ltd., Toronto, Winnipeg and St. John, N. B.; Williams & Wilson, Ltd., Montreal. **FOREIGN AGENTS:** Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Newcastle-on-Tyne, Glasgow. Alfred H. Schutte, Cologne, Berlin, Brussels, Paris, Milan, Barcelona, Bilbao, Lisbon and Petrograd. Donauwerk Ernst Krause & Co., Vienna. V. Lowener's Maskinforretning, Sverre Mohn, Norway, Bevan & Edwards Pty., Ltd., Melbourne, and White & Rae, Sydney, Australia. Also all manufacturers of Screw Machines and Turret Lathes.

Heald Internal Grinding

On Which the Actual Limit is only 0.0001"





Machining or grinding actually held to 0.0001 part of an inch limit is extremely rare even in these days of close work. Many times you will be told work is within these limits when as a matter of fact it is nearer 0.0005 inch. But at the North East Electric Company's plant in Rochester, N. Y., through whose courtesy this photograph was taken, the limits on this grinding job actually are plus or minus 0.0001 inch. The sketch shows the job, the grinding of a hole in a 3½ per cent nickel steel heat-treated sprocket used on an electric starter. There is 0.005 inch of stock to come out, and production is over 300 pieces in eight hours.

In working down to this close limit the gages do not last over two weeks before they are worn down too small for use. In spite of the fact that the work is held so close, this Heald Machine is giving excellent satisfaction—as are the four other Heald Machines working on electric starter parts in this plant.

Your grinding cannot be too accurate to be handled in a Heald Grinder. Catalogue shows both Internal and Cylinder Grinders. Send for a copy.

THE HEALD MACHINE COMPANY

20 NEW BOND STREET **WORCESTER, MASS.**

CHICAGO, 24 So. Jefferson St.
DETROIT, 303 Majestic Bldg.

BRANCHES

CINCINNATI, 602 Provident Bank Bldg.
CLEVELAND, 710 Engineers Bldg.

DOMESTIC AGENTS: Prentiss Tool & Supply Co., New York, Boston, Syracuse, Rochester, Buffalo, Scranton. Smith-Booth-Usher Company, Los Angeles, Cal. Eccles & Smith, San Francisco, Cal. **FOREIGN AGENTS:** Alfred Herbert, Ltd., England, Italy, France, Belgium, Switzerland, Spain and Portugal. Ludw. Loewe & Co., Germany and Austria. F. W. Horne Co., Japan. Wilh. Sonesson & Co., Ltd., Sweden, Denmark and Norway. Post van der Burg & Co., Rotterdam, Holland.

How Would You Hold 104 of These Pieces?

This is what we call a "real" magnetic chuck job. It consists of holding 104 needle pointing dies at once while the operation of grinding on one side is being performed. They are ground on four sides in this manner, and the time saved by the use of the Heald Magnetic Chuck is almost beyond calculation. Can you conceive of holding them one at a time, since they are little blocks of steel approximately 5/8 inch square, and grinding them that way?

Grinding these dies on four sides, accurate, smooth and square, 104 at a time, consumes only about three minutes each. Remarkable time!

These dies are used for making knitting needles at the factory of the Page Needle Company, Chicopee Falls, Mass.

Note also the Heald Demagnetizer on the bench, the operation of which consists merely of turning on the electric current and wiping the parts to be demagnetized across the top of the demagnetizer. Could anything be more simple?

The holding power of Heald Chucks is remarkable. They are used successfully for milling as well as grinding. We will gladly tell you more about their adaptability to your work if you will let us know its nature.

One Good Way is on a HEALD Magnetic Chuck

THE HEALD MACHINE COMPANY

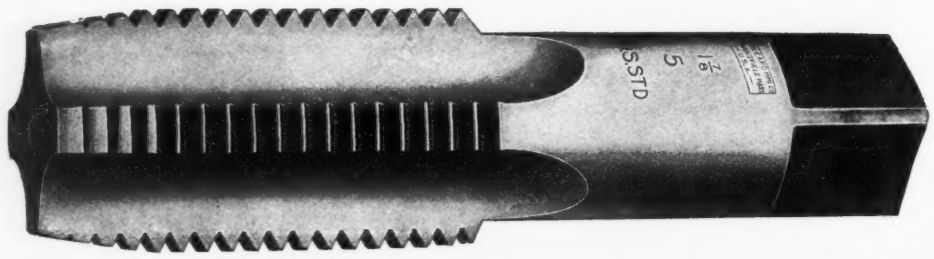
20 NEW BOND STREET
WORCESTER, MASS.

CHICAGO, 24 So. Jefferson St.
DETROIT, 303 Majestic Bldg.

BRANCHES

CINCINNATI, 602 Provident Bank Bldg.
CLEVELAND, 710 Engineers Bldg.

FOREIGN AGENTS: Alfred Herbert, Ltd., England, Italy, France, Switzerland. F. W. Horne Co., Japan. Post van der Burg & Co., Rotterdam, Holland.



CARD TOOLS

Fully Guaranteed

If they're CARD taps and dies, you're using just what hundreds of other manufacturers have adopted exclusively. CARD Tools have been found to give greatest satisfaction, often under seemingly impossible conditions.

CARD Taps and Dies are fully guaranteed. You are assured of more than ordinary service from them—they will do everything a thoroughly good tool *should* do.

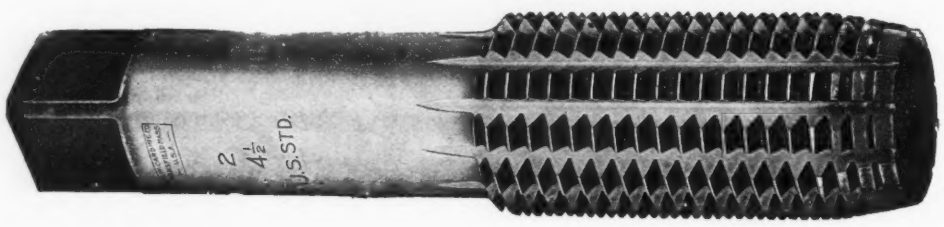
CARD Service is at the disposal of every machinery manufacturer. If you are not getting the right results from your taps and dies and you find difficulty in knowing "why," put it up to CARD Service to answer. We will cheerfully recommend the proper tap or die to use. All we ask you to do is to *try* CARD Tools. There's a big difference in the quality and quantity of service CARDS give and the service you may now be getting.

Write for a copy of new Catalog 28.

S. W. Card Manufacturing Co.

MANSFIELD New York Office, 62 Reade St. **MASS., U. S. A.**

EUROPEAN AGENTS: Chas. Churchill & Co., Ltd., London, Birmingham, Manchester and Glasgow; Markt & Co., Ltd., Paris; Fenwick Freres & Co., Turin; Ignacz Szekely, Budapest; V. Lowener, Stockholm, Copenhagen, Christiania; R. S. Stokvis & Zonen, Ltd., Rotterdam; R. S. Stokvis & Fils, Brussels; Andrews & George, Yokohama, Tokio, Osaka; J. Lambercier & Co., Geneva; R. D'Aulignac, Barcelona, Spain; Arthur Kayser, Berlin S. W. 68, Oranienstr., 126, Germany.



NEW, NOVEL AND INTERESTING

The New Slocomb Combined Catalogue and Measuring Book No. 15

THIS catalog is now ready. It supersedes all other editions, and shows some new tools.

Prices have been revised.

The Measuring Book has considerable new and interesting matter—besides something about micrometers never before published. A copy is yours for the asking.

J. T. Slocomb Co.

Providence Rhode Island

FOREIGN AGENTS: Representatives in England, Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow. Representatives in Germany and Austria-Hungary, F. G. Kretschmer & Co., Frankfort-am-Main. Chas. Civita, Milan, Italy.

COUPON

J. T. SLOCOMB CO.
Providence
Rhode Island
Please send a copy of your Catalogue No. 15.

Name.....

Address.....

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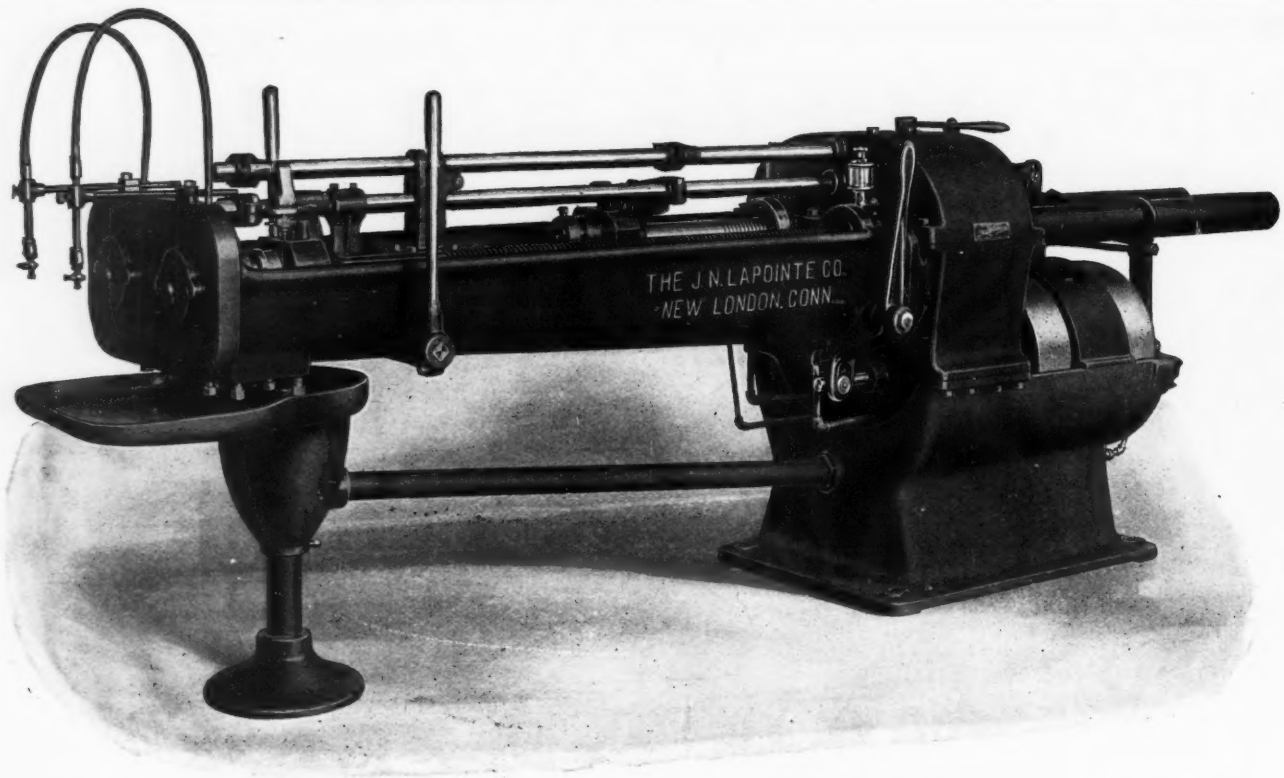
State.....

Machinery 8-16



J. N. LAPOINTE

Keep that Name in Mind in Connection with

BROACHING

It means economy and clean cut work—freedom from the many problems that confront users of ordinary broaching machines—ability to handle a wider range of work by broaching. We originated the modern broaching system and developed our machines to meet the requirements of modern practice.

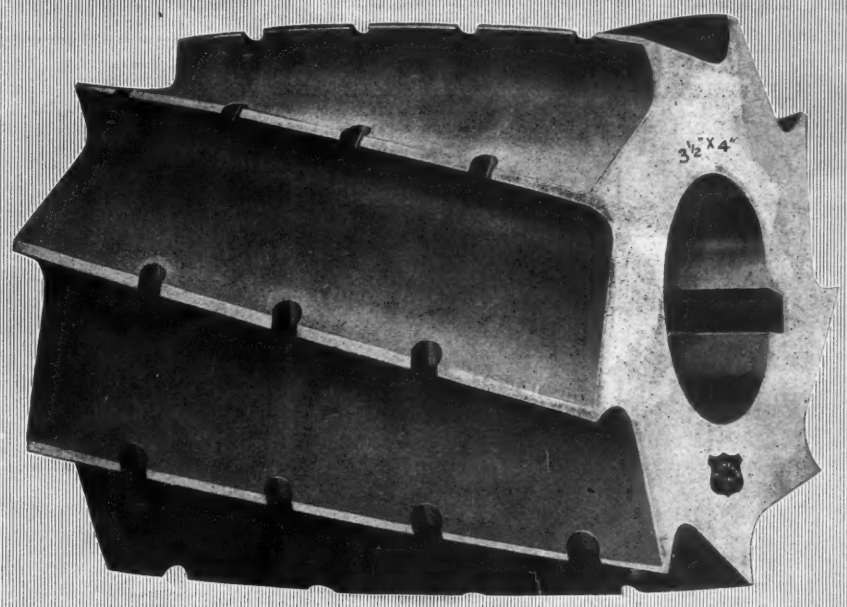
The machine above is typical of the efficient design of the J. N. Lapointe Co.'s line. The No. 3 Double requires but one operator, and practically doubles the production. The machine is arranged so that one spindle can be disengaged and the machine can be run as a single machine. It also contains many other patented features. The stroke can be set to any length and can be operated from either side of the machine.

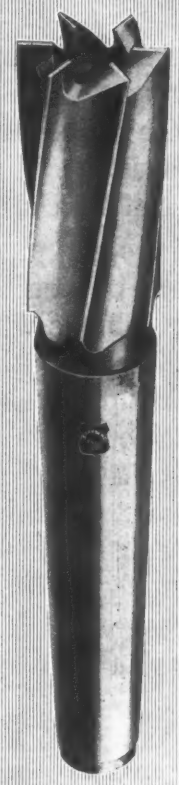
If you have difficult broaching problems get in touch with us. Our experience as specialists is at your service.

The J. N. Lapointe Company

New London Conn., U. S. A.

This is the kind of work our broaching machines accomplish. It isn't ordinary work either.





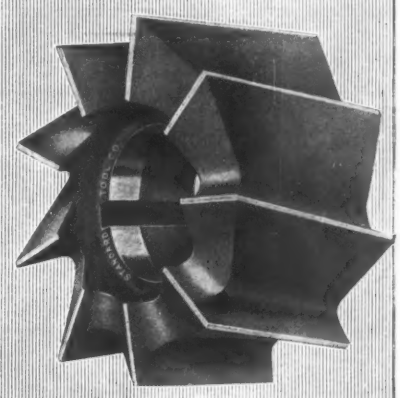
SHIELD BRAND MILLING CUTTERS
WITH WIDE-SPACED TEETH

THESE are high efficiency Cutters for high-power milling machines.

They are specially designed to increase production, and for this purpose, they should be used in your shop.

We make them in all styles and sizes.

Write for further information.



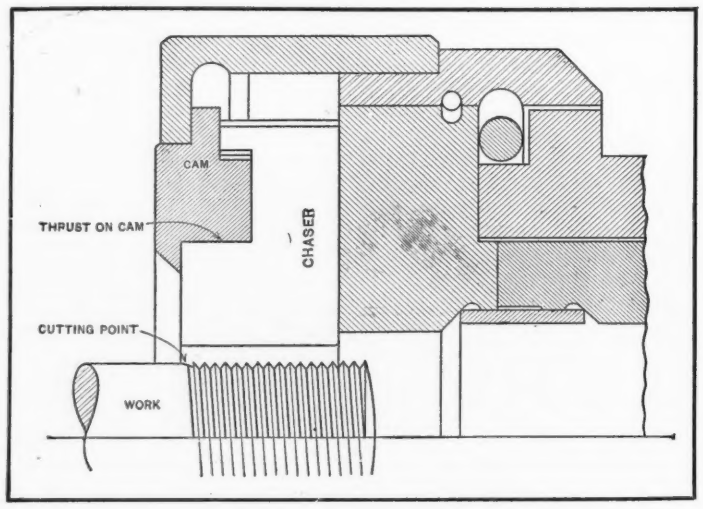
THE STANDARD TOOL CO.
CLEVELAND—SIXTH CITY—U. S. A.

New York Store at - - - - - - - - 94 Reade Street
Chicago Store at - - - - - - - 552 W. Washington Blvd.

London—C. W. Burton, Griffiths & Co. - - - Paris—Burton Fils.
Geneva—J. Lamberçier & Co. - - Brussels—Honore Demoor & Cie
Copenhagen—Nienstaedt & Co. - - - - - - Tokyo—F. W. Horne

The Chasers are held to their work in the Hartness Automatic Die

The faults of taper threading, stiff action and undue wear of mechanism in a die holder are due principally to improper provision for resisting the thrust of the chasers.



The proper place to support the chasers is directly over the cutting edge. This is where the closing cam should take its bearing, and this is where it does take its bearing in our die holder. See illustration. It then makes little difference whether or not the rear end of the chaser tips up under the pressure of the work. The front end, which is the cutting end, is held closely to size. A closing cam applied to the rear face of the chaser is not in good position for maintaining the diameter throughout the length of the cut.

JONES & LAMSON MACHINE CO., SPRINGFIELD, VERMONT, U. S. A.
97 QUEEN VICTORIA ST., LONDON, E. C.

DOMESTIC AGENTS: Boyer-Campbell Co., Detroit, Mich.; E. L. Essley Mchy. Co., Chicago, Ill.; Robinson, Cary & Sands Co., St. Paul, Minn.; Carey Mchy. & Supply Co., Baltimore, Md.; Barwood-Richards Mchy. Co., The Bourse, Philadelphia, Pa.; Machinists' Supply Co., Pittsburgh, Pa.; The E. A. Kinsey Co., Cincinnati, O.; The E. A. Kinsey Co., Indianapolis, Ind.; Pacific Tool & Supply Co., San Francisco, Cal.; The W. M. Pattison Supply Co., Cleveland, Ohio. **FOREIGN AGENTS:** F. Auberty & Co., 91 Rue de Maubeuge, Paris, France; M. Koyemann, Charlottenstrasse 112, Dusseldorf, Germany; McPherson's Pty., Ltd., Melbourne, Australia.

OHIO PLANERS

Heavy Pattern Several Sizes
Plain or Reversing Motor Drive

Latest designs in metal planing machines. Built for accurately machining the heaviest classes of work at the maximum capacity of high speed steel tools. Powerful machines, yet simple and economical to operate.

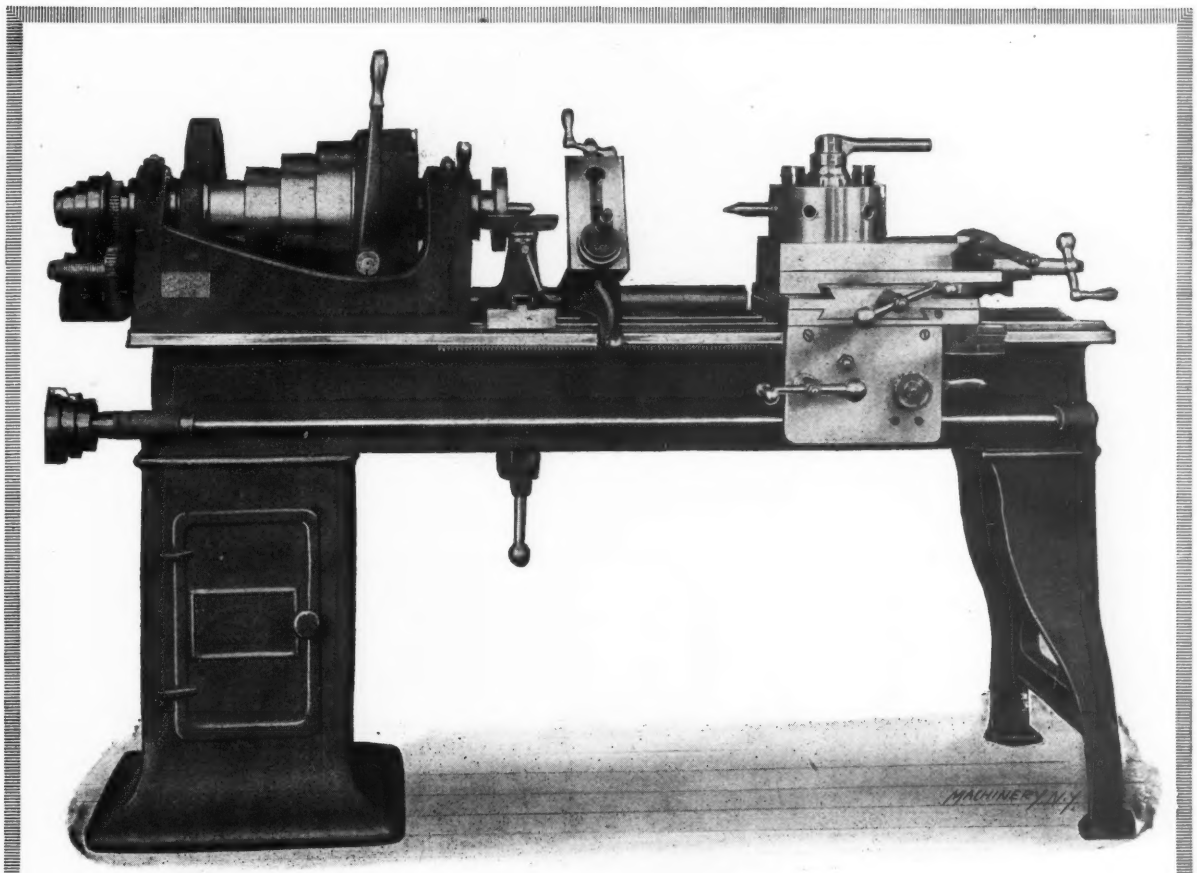
OHIO PLANERS—Built for 30 years on a Quality basis—now Better than Ever. Let us send complete description.

THE OHIO MACHINE TOOL CO.

KENTON, OHIO, U. S. A.

Fox Monitor Turret Lathes

WITH FRICTION HEAD



Fast, Accurate Machines for General Brass Work

FOR rapid, accurate production of general brass work, variety of work handled, large number of possible combinations, capacity, range, economy and convenience, Fox Monitor Turret Lathes have no superiors and few equals.

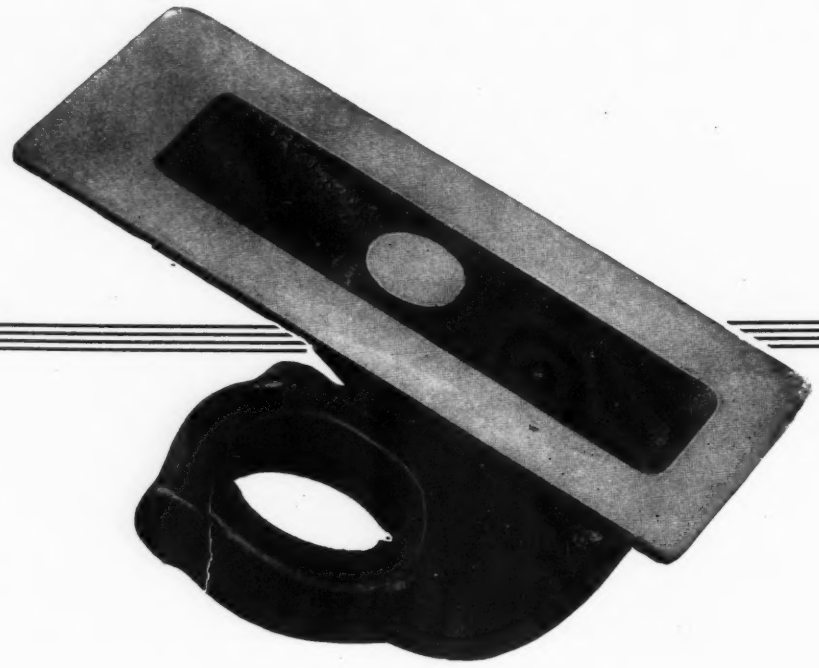
The Chasing Attachment is heavy, true, and is so arranged that right or left threads may be cut without changing the leader, and taper threads may also be chased. When not in use it may be placed entirely aside. The Turret is provided with hand longitudinal and cross feeds, is also equipped with longitudinal feed, in either direction, by power and is fitted with Taper Attachment so that taper holes may be bored or taper work turned by turret tools. The entire Turret is gibbed and dovetailed, which gives it a rigidity that could be secured by no other method of construction.

Fox Monitors will meet any brass lathes in the market in point of design, production and capacity. Why not give them a chance to prove it in your shop? Send for catalogue.

The Springfield Machine Tool Co.

631 Southern Avenue, Springfield, O.

MANUFACTURERS OF SPRINGFIELD LATHES AND SHAPERS



BECKER

CONTINUOUS

Increased Production 600%

A similar case presented itself in the manufacture of these malleable iron Fan Brackets. This manufacturer too, was satisfied with his production until we showed him the possibilities of continuous milling. He tried it. Now one Becker Continuous Milling Machine finishes as many brackets as ***six*** of the horizontal machines. The experience of these manufacturers indicate money saving production, increasing possibilities for ***you.*** You are decidedly the loser if you fail to investigate them. Write us ***to-day.***

BECKER MILLING

HYDE PARK

AGENTS: Manning, Maxwell & Moore, Inc., New York, Philadelphia, Pittsburgh, Chicago, St. Louis, San Francisco, Seattle, Milwaukee and Cincinnati. H. B.

MILLING

MILLING

Increased Production 400%

When the manufacturer of these Ignition Brackets finished them on horizontal milling machines, his output was 135 pieces per machine in a 9-hour day. He considered that good production until he heard of the Becker way. He decided to try Becker Continuous Milling, with the result that his daily output jumped to 540 pieces per machine—just four times as great. Needless to say he is now a Becker enthusiast.

MACHINE COMPANY

Slate, Hartford, Conn. National Supply Co., Toledo, O. Selson Engineering Co., Ltd., London. Schuchardt & Schutte, Berlin. Allied Machinery Co. of America, Paris.

MASS., U. S. A.

External Limit Gauge

Taft-Peirce Tool Room Specialties

We make a full line of time-saving tool room specialties. Catalog "B" describes them. May we mail you a copy?

Economical Accuracy

Work finished to Taft-Peirce Gauges is accurate—that goes without saying. But aside from that, there is the advantage of having every piece in the lot exactly similar—all positively interchangeable. A man would experience great difficulty, would lose much time, trying work and holding it to close limits with a caliper. With Taft-Peirce Gauges this is accomplished quickly, positively and surely.

These gauges form permanent, accurate standards for work. No argument between workmen and inspectors over sizes—work fits the gauge or it doesn't, and is right or wrong accordingly. Taft-Peirce Gauges *stay* right. Heavy, ribbed construction prevents springing, and they are made to hold their original accuracy for a long time even in the hardest service.

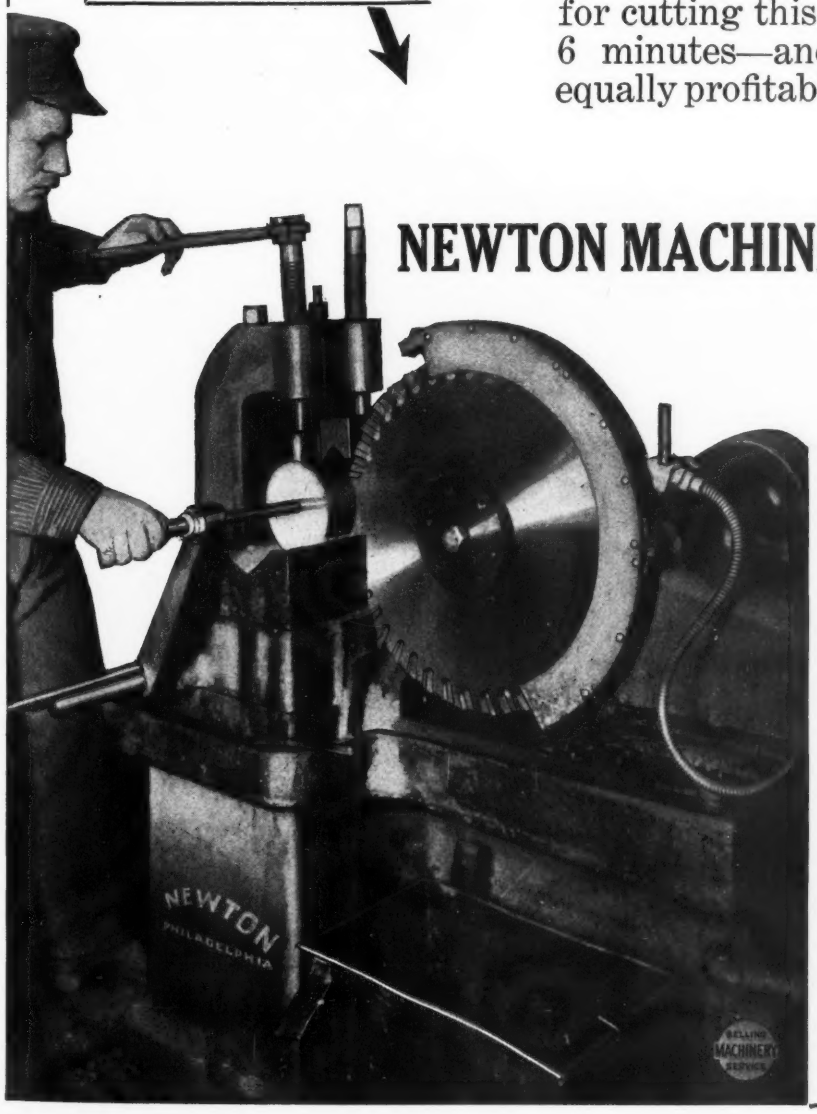
THE TAFT-PEIRCE MANUFACTURING CO.
WOONSOCKET, RHODE ISLAND, U. S. A.
NEW YORK: 233 Broadway **DETROIT: 1311 Majestic Building**

Registered Trade Mark **NEWTON** Registered Trade Mark

Six Minutes is the Sawing Time for this 5½-inch Bar on the Inexpensive Newton No. 197-C.

THE Eclipse Machine Company, Elmira, N. Y., maker of the famous "Eclipse" and "Morrow" Coaster Brakes, uses a Newton Cold Saw for cutting up the stock which goes into these and other devices.

Most of this stock is of fairly large diameter—the 5½″ steel bar shown, for example—cut into short lengths. For this purpose the No. 197-C Newton is an ideal machine. Motor drive makes it a complete unit in itself and the operator need not be a skilled hand, since all Newton Saws are easy to run and keep in order. The time for cutting this particular 5½″ steel bar is 6 minutes—and other sizes are cut at equally profitable rates in the Eclipse shops.



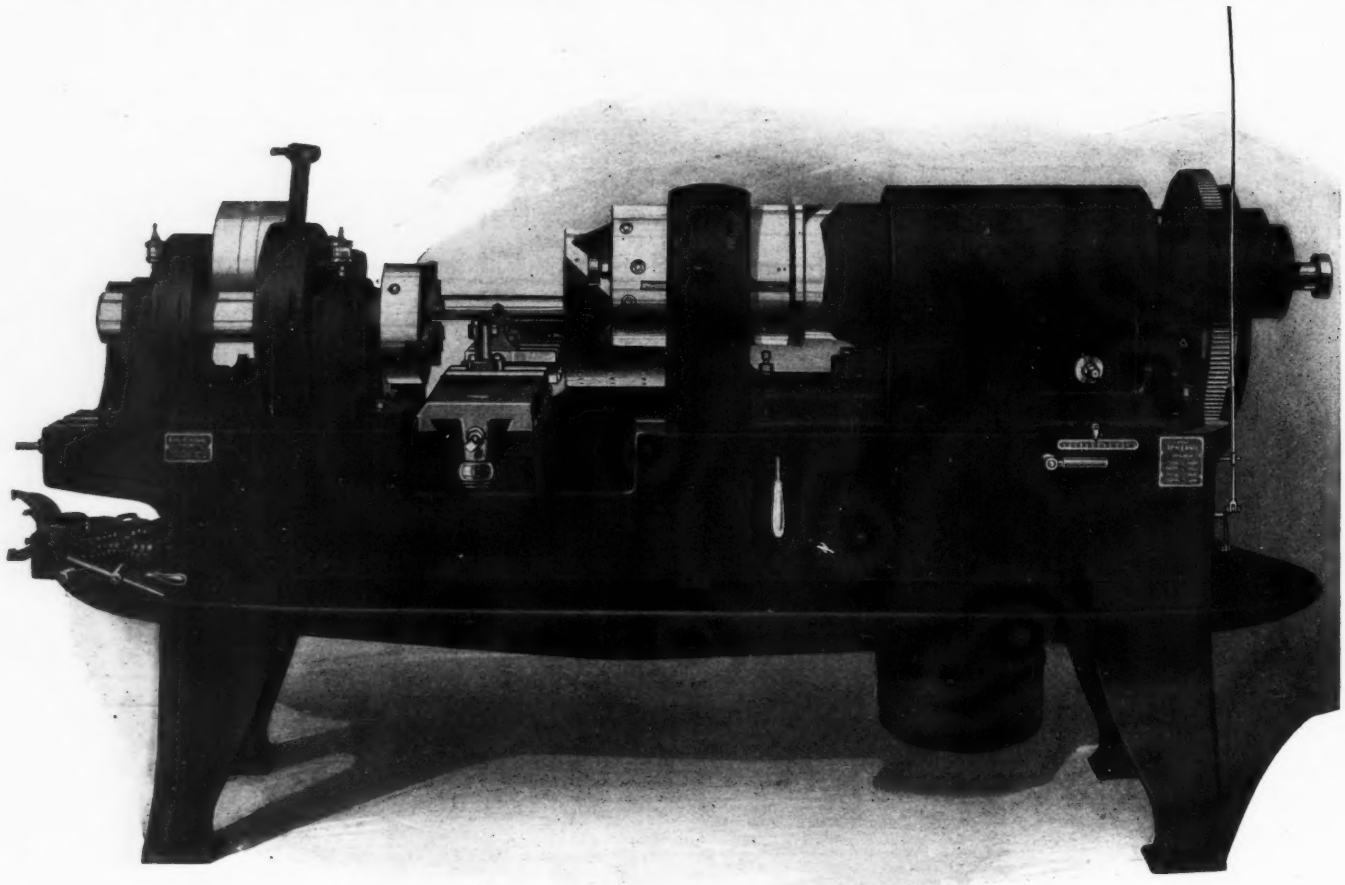
NEWTON MACHINE TOOL WORKS, Inc.

23rd and Vine Streets
PHILADELPHIA, U. S. A.

Our No. 197-C is a small, inexpensive machine, but a most profitable tool for many purposes, as its rate of output is truly remarkable in proportion to its first cost.

Other sizes and kinds with capacity for rounds up to 24" diameter, I-Beams up to 30".

Cleveland Automatics



Promise and Performance

Very often the prospective buyer of an automatic is confronted with alluring promises of large output. Under ideal conditions and with expert operators, such output is possible. But such promises are deceiving, in so far as they cannot be maintained under normal shop conditions. No allowance is made for changing jobs, no account is taken of the time lost through complicated mechanism, difficult camming and tooling.

What we promise, a CLEVELAND *can do—all the time.* We claim that an operator of ordinary ability can produce a consistently good output; that he can change jobs on a CLEVELAND in from one-half to three hours on 90 per cent of his work.

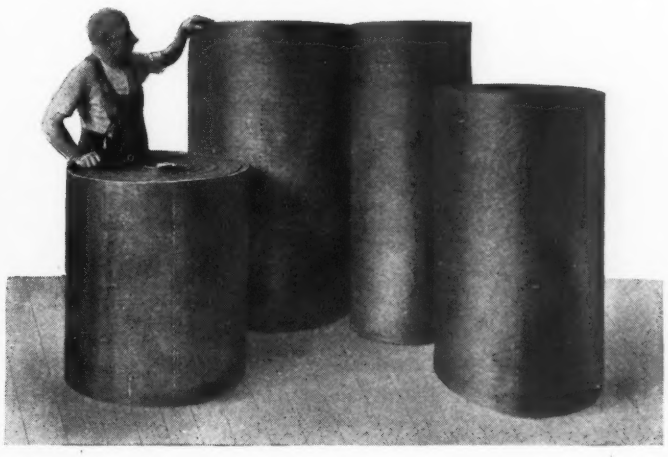
We know that the CLEVELAND will stay on the job, and is good for years of continuous service. The repair man will have less to do with a CLEVELAND than with any machine you own. The experience of scores of satisfied users will back up this statement. The CLEVELAND is, first of all, a machine of performance. What it has done for others it will do for you. Let us tell you why so many manufacturers find it a big profit maker.

Cleveland Automatic Machine Company

Cleveland, Ohio, U.S.A.

EASTERN REPRESENTATIVE: J. B. Anderson, 211 Gowan Ave., Mt. Airy, Philadelphia. **WESTERN REPRESENTATIVE:** Herbert E. Nunn, 565 West Washington St., Chicago. **FOREIGN REPRESENTATIVES:** Chas. Churchill & Co., Ltd., London, Manchester, Birmingham, Newcastle-on-Tyne and Glasgow.

10 Miles of VIM Leather Belt for Jones & Laughlin Steel Co.



THE two rolls in the center of photograph are for a 10-inch Skelp Mill drive designed by Morgan Construction Co., Worcester, Mass., for Jones & Laughlin Steel Co., Pittsburgh, Pa.

One belt is 125 ft. long, 3-ply thick, 60″ wide, and the other is 65 ft. long, 2-ply thick, 60″ wide, both to work over the same driving pulley. The former belt transmits 1400 H. P. and weighs 1865 lbs., nearly a ton, while the latter transmits 600 H. P. and weighs 650 lbs.

LEATHER TRADE VIM MARK BELT

"The Belt that puts the pull in the pulley"

The roll on the left end is 146½-foot two-ply VIM Belt 34 inches wide, and the one on the right is 118-foot two-ply VIM Belt 48 inches wide. The four belts required 485 French steer hides, the equivalent of 52,800 ft. (10 miles) of 1″ single belting. While the goal of the VIM Shop is quality and not "miles per day," this shipment is an example of our facilities for *quantity of quality belting*. One VIM Leather Belt will win you.

Since 1865

E. F. HOUGHTON & CO.

Publishers of The HOUGHTON LINE

Third and Somerset Streets Philadelphia, U. S. A.

NEW YORK BOSTON HARTFORD SYRACUSE BUFFALO BALTIMORE PITTSBURGH CLEVELAND CINCINNATI ST. LOUIS DETROIT

England and Wales: Edgar Vaughan & Co., Ltd., Birmingham, England. Scotland: Jas. S. Crawford & Sons, Glasgow. Spain: La Maquinaria Anglo-Americana, Barcelona.

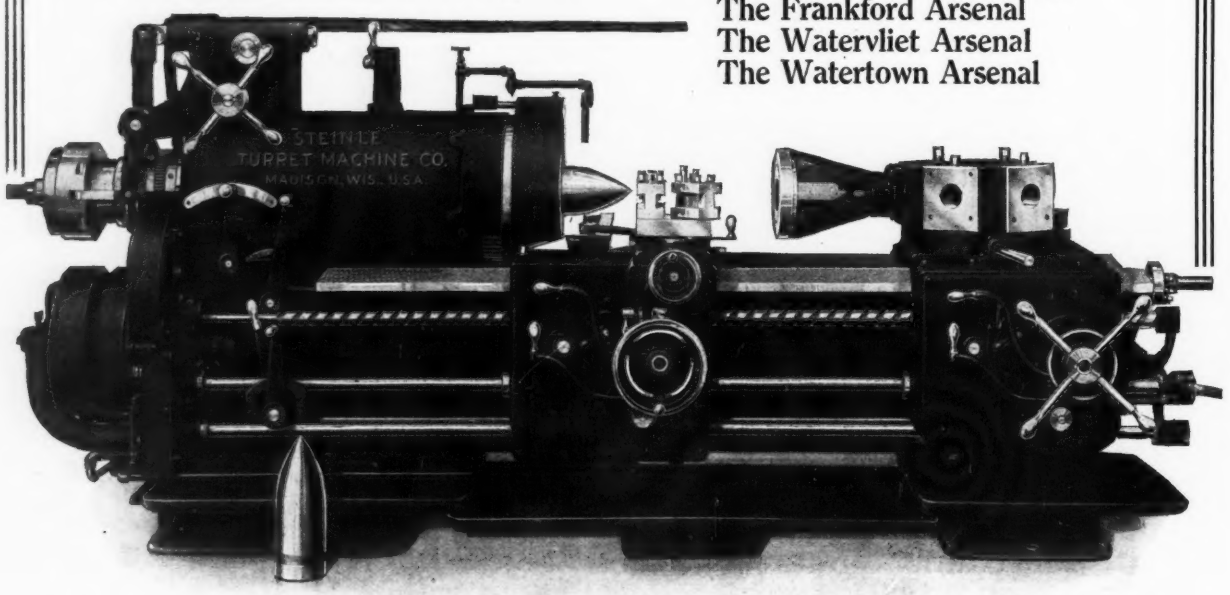
The Bethlehem Steel Company Uses 150 Steinle Turret Lathes

A formidable battery indeed—one that enables the Bethlehem people to turn out projectile work on contract time. An order for 150 machines from a firm like that is evidence of the ability of the Steinle Full Swing Turret Lathe to meet exacting production requirements under unusual conditions. It is, in fact, an ideal tool for projectile work. Strongly built and exceptionally powerful. A pacemaker that piles up substantial profits and makes prompt deliveries possible.

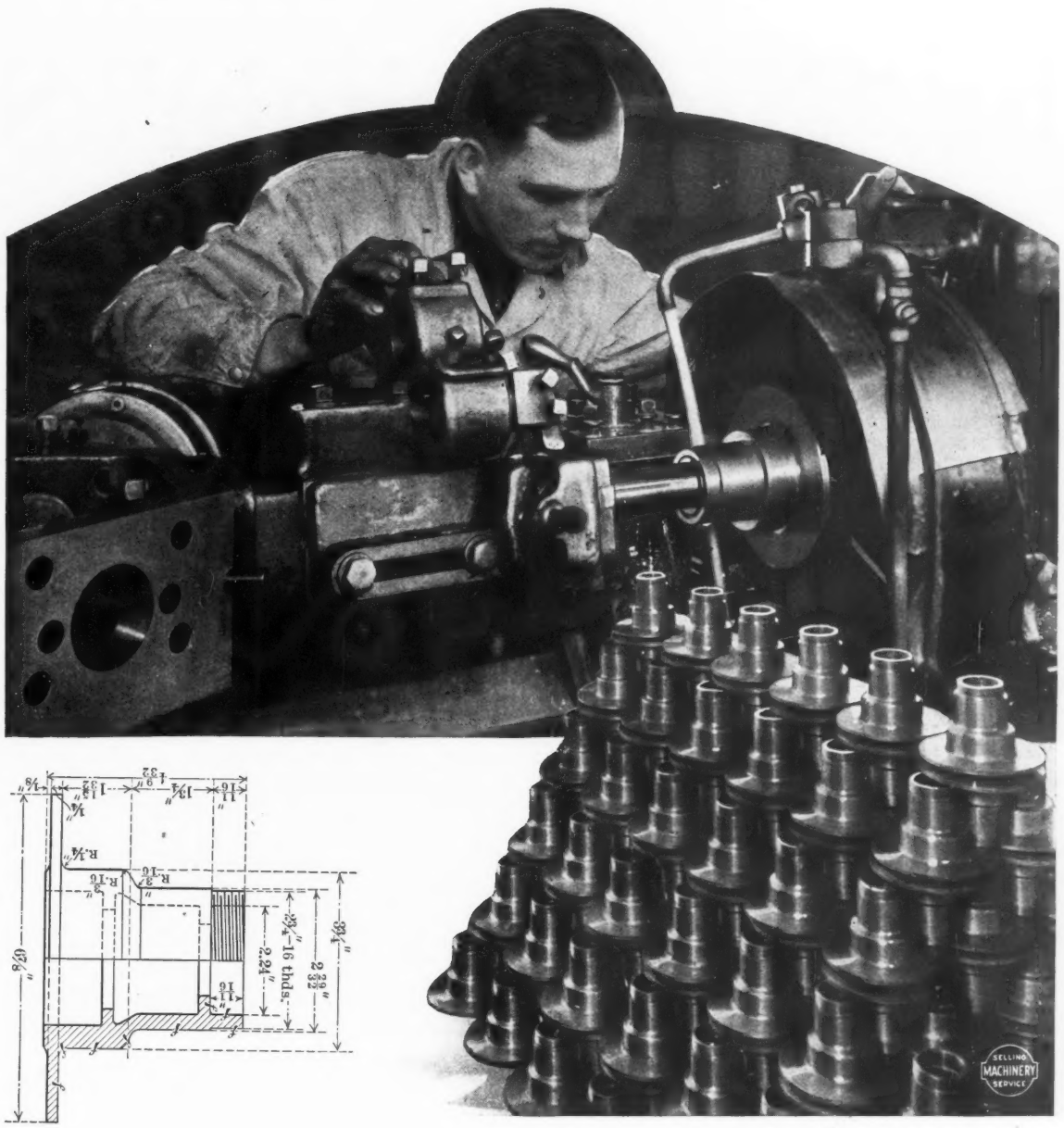
Another big point: Fitting a Steinle Lathe for projectile work in no way interferes with its capacity as a general manufacturing machine. That's important. The Steinle is no single-purpose war investment. It is a standard machine, long famous as a consistent producer—it is a long-time investment that will pay big dividends. For the present rush and for future expansion, we can show you where this machine will fill a real need in *your* shop. Write us about it.

Among Other Prominent Users of Steinle Turret Lathes for Projectile Work are

Crucible Steel Co. of America
Washington Steel and Ordnance Co.
Westinghouse Electric & Mfg. Co.
The John Inglis Co. (Canada)
Coburg Steel Co. (Canada)
The Krupp Co. (Germany)
The Frankford Arsenal
The Watervliet Arsenal
The Watertown Arsenal



STEINLE TURRET MACHINE COMPANY
MADISON, WISCONSIN, U. S. A.



A BETTER DAY'S WORK

After several years' steady service, the Universal Hollow-Hexagon Turret Lathe turns out a better day's work on hubs for gas tractor front wheels than any other machine in the plant of the J. I. Case Threshing Machine Company—and within exceedingly close limits.

The hubs are 6 7-8″ across the flange, 4 9-32″ long—machined on all outer surfaces and inside one end for bearings. The limit on the flange is 0.004″; on thread, 0.001″; in bearings, 0.001″.

The Universal Hollow-Hexagon Turret Lathes turn out a better day's work because they take two cuts at one time—face or undercut or form with the carriage while boring or turning with the turret.

Write for descriptive literature explaining many advantages.

The Warner & Swasey Company

CLEVELAND, OHIO, U. S. A.

TURRET LATHES—TURRET SCREW MACHINES—BRASS WORKING MACHINE TOOLS

New York Office—Singer Bldg. **Boston Office**—Oliver Bldg. **Buffalo Office**—Iroquois Bldg. **Detroit Office**—Ford Bldg.
Chicago Office and Show Rooms—618-622 Washington Blvd.

FOREIGN AGENTS: Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Newcastle-on-Tyne, and Glasgow. Schuchardt & Schutte, Berlin, Vienna, Budapest, Petrograd, Stockholm, Copenhagen, Shanghai and Tokio. Alfred H. Schutte, Cologne, Brussels, Liege, Milan, Bilbao and Barcelona. Benson Brothers, Sydney. A. Asher Smith, Sydney. A. R. Williams Machinery Co., Ltd., Toronto, St. John, Winnipeg and Vancouver. Williams & Wilson, Ltd., Montreal.

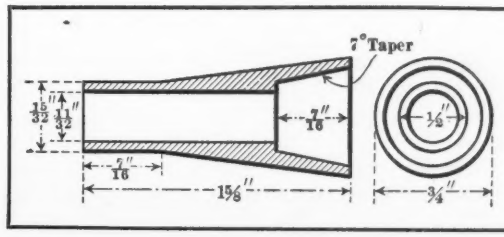
The "New Britain" Six-

The "New Britain" Automatic Screw Machine has a 20 per cent advantage over its 5-spindle predecessor and a 50 per cent advantage over 4-spindle machines, because it has six spindles. That means more end-working tools can be used on this machine than on any other. And here's actual proof of the big saving.

THE NEW BRITAIN MACHINE

Spindle Screw Machine

This particular machine was installed at one of Connecticut's largest metal working factories, alongside a roomfull of machine of other makes. It has been running continuously for a year and a half on the same job—the one we show in the sketch. It is a ferrule, made of cold-rolled steel, length 1⅝" and greatest diameter ¾".



Over-all length . . 1⅝"
Greatest diameter ¾"
Production 625 in ten hours.

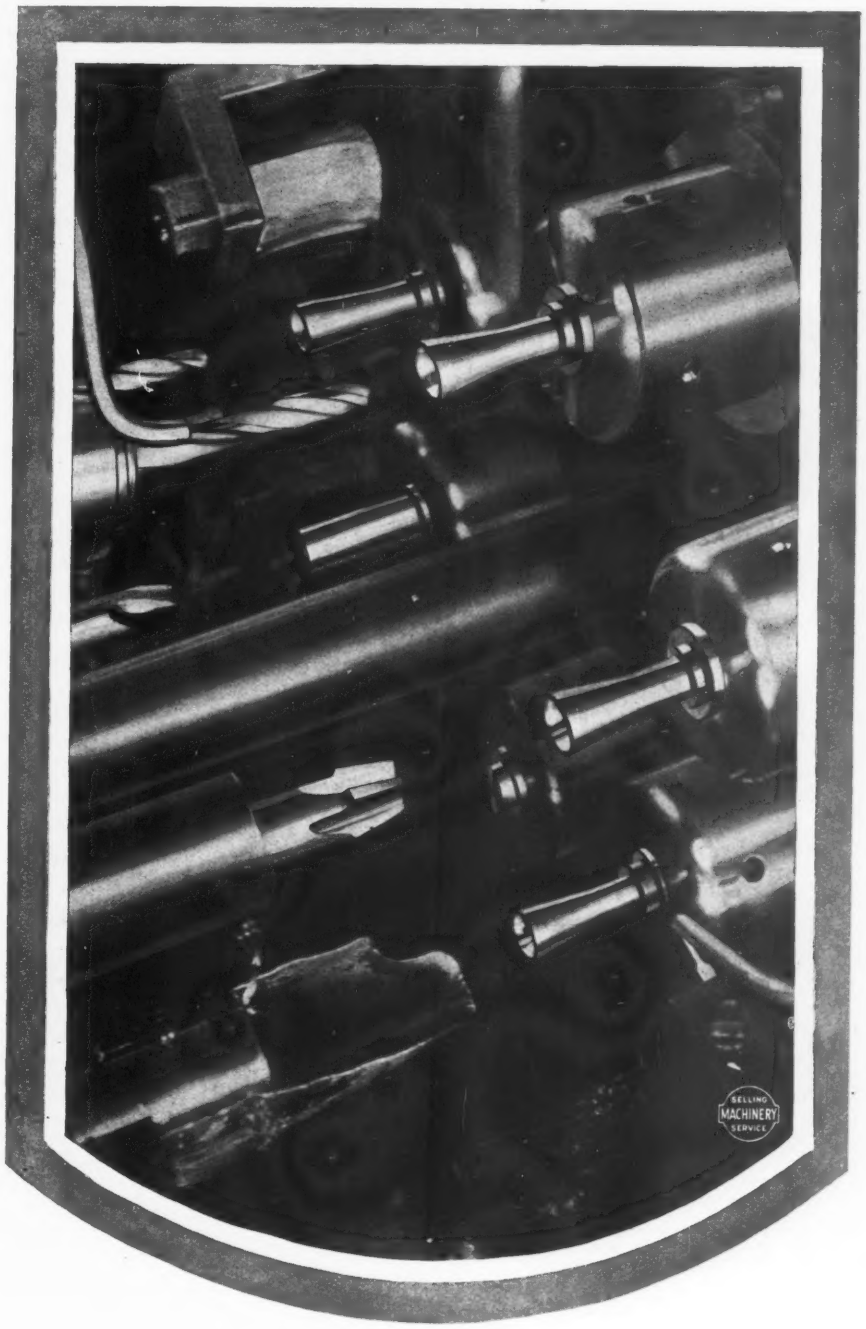
The operations are:

1st —rough form and drill with ⅜" drill.
2nd—finish form, drill small hole part way.
3rd —finish drill small hole.
4th —ream the 7-degree taper.
5th —cut off the stock.
6th —feed the stock to stop for new piece.

The total machining time for this part is just 47 seconds. The average production per day of ten hours is 625 pieces. The best former production on four or five spindle machines was 525 pieces.

The moral is plain. More end working tools mean higher production when everything else is equal, and other things are more than equal on "New Britain" Automatics. Upkeep is almost nil. Tool maintenance is low because tools are rigidly supported. On this job we've just cited, the forming tools are ground at intervals of *three days*. And look at the size of the forming chip the operator is holding.

It would pay you to investigate the money-saving possibilities of the "New Britain" on your particular work. Are you ready to be "shown"?



COMPANY, New Britain, Conn., U.S.A.

ESTABLISHED SINCE 1837

H. BOKER & CO., Inc.

formerly

HERMANN BOKER & CO.

101 Duane Street
New York

CHICAGO
CLEVELAND

MONTREAL
BOSTON

NOVO STEEL

NOVO SUPERIOR

INTRA STEEL

WE wish to assure our trade that the firm of **H. Boker & Co., Inc.,** represents the identical policies, the same grades of steel and specialties and is conducted by the same management as formerly under the name of

HERMANN BOKER
& CO.

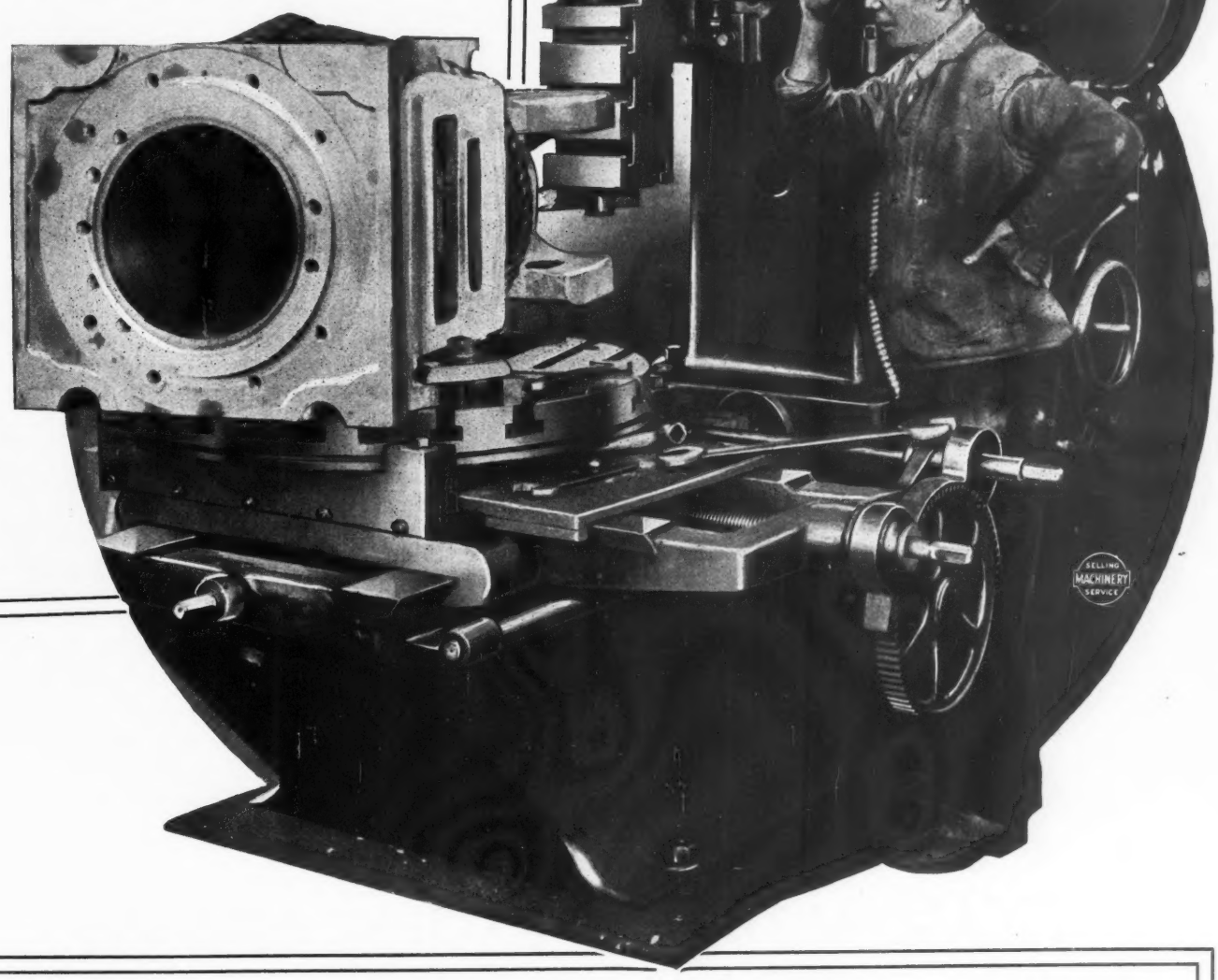
Helping Uncle Sam Prepare

There's plenty of work for the Dill Slotter in Uncle Sam's preparedness plans, not only in the government's own plants, but in the contractor's shops as well. The accompanying photo shows one of the latter, used for machining all surfaces on submarine engine cylinder castings that can't be touched with a planer—and it does this work with customary Dill thoroughness. The Dill Slotter is an accurate machine, adaptable, a good producer—and costs 90 cents a year (average of all Dill Slotters in use) for maintenance.

The DILL Slotter

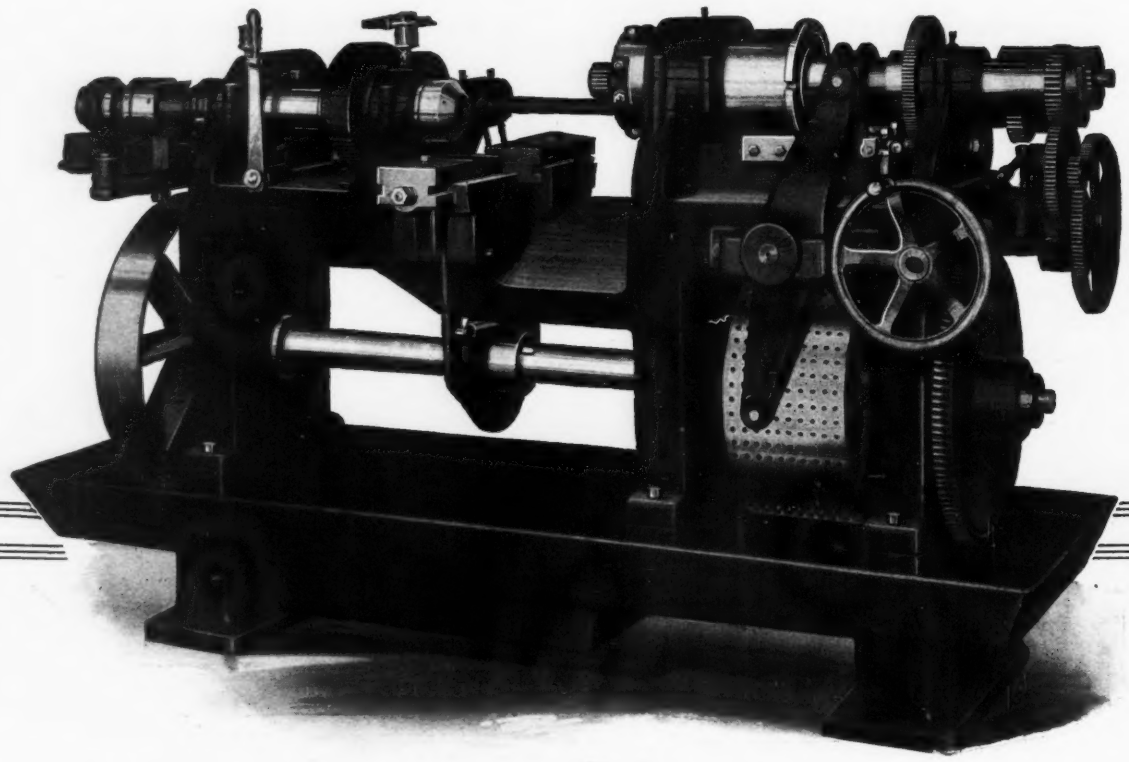
Several Sizes

Send for Catalogue



T. C. DILL MACHINE CO. **THE DILL SLOTTER PEOPLE** **PHILADELPHIA PA., U. S. A.**

FOREIGN AGENTS: Coventry, London, Birmingham, Leeds, Manchester, Newcastle-on-Tyne and Glasgow: Alfred Herbert, Ltd. France: Alfred Herbert, Ltd. Italy: Alfred Herbert, Ltd. Japan: Alfred Herbert, Ltd., Yokohama. Germany and Austria: Heinrich Dreyer, Berlin, Germany. Holland: R. S. Stokvis & Zonen, Ltd., Rotterdam. Belgium: R. S. Stokvis & Fils S.A., Brussels.



You can Cam-up a Chicago Automatic in an Hour, or Less

One of the advantages of the Chicago Automatic Screw Machine is the simplicity of the camming system—no cams to make, simply bolt blocks to the drum as required for the various operations, and it won't take an hour to do it except in one case out of a hundred. The time-saving accomplished in setting up this machine, compared with automatics in which more or less complicated mechanisms must be arranged, is remarkable.

No countershaft is required—the machine is equipped with a fast and loose pulley on the spindle head, this being the only belt drive on the machine.

Spindle speeds suitable to different sizes and kinds of stock within the capacity of the machine are obtained by changing two gears on the spindle head.

The intermediate spindle shaft is extended to the feed bracket and connected to the cam shaft by a clutch operated by a hand lever, conveniently located in the front of the machine. Different feeds are obtained by changing two of the feed gears.

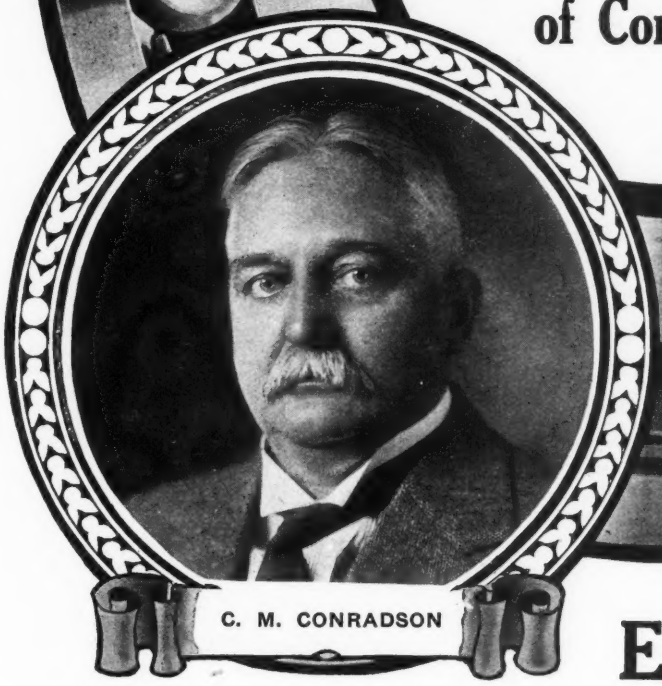
A clutch mechanism is used to index the turret which can be arranged to skip one or more holes when all the turret holes are not being used. Either a four or five hole turret can be supplied.

Four sizes—¾" to 2". Send for catalogs.

CHICAGO AUTOMATIC MACHINE COMPANY

CHICAGO, ILLINOIS, U. S. A.

Eastern Representative: John Macnab Machinery Co., 90 West St., New York.
Foreign Representative: John Macnab, Hyde, England.



Who's Conradson?

C. M. Conradson is a genius; the designer of many labor-saving machines and accessories; known wherever machine tools are made or used.

What he says about S K F Ball Bearings and how their use actually lowers the cost of building a machine is particularly interesting.

Engineering Opinion

Writing of S K F Ball Bearings and his experience with them, Mr. Conradson says:

"I have used them with perfect success in my Multiple Spindle Automatic Lathe, and also in the Duplex Helical Drive Engine Lathe, built by the Phoenix Manufacturing Company, and in other machines.

"When correctly proportioned for the work to be done and properly installed, they give complete satisfaction as regards durability, reliability and efficiency.

"New designs now going through the drawing room include machines using S K F bearings from 10 mm. to 270 mm.

"In some cases the use of S K F bearings actually lowers the cost of construction of a machine.

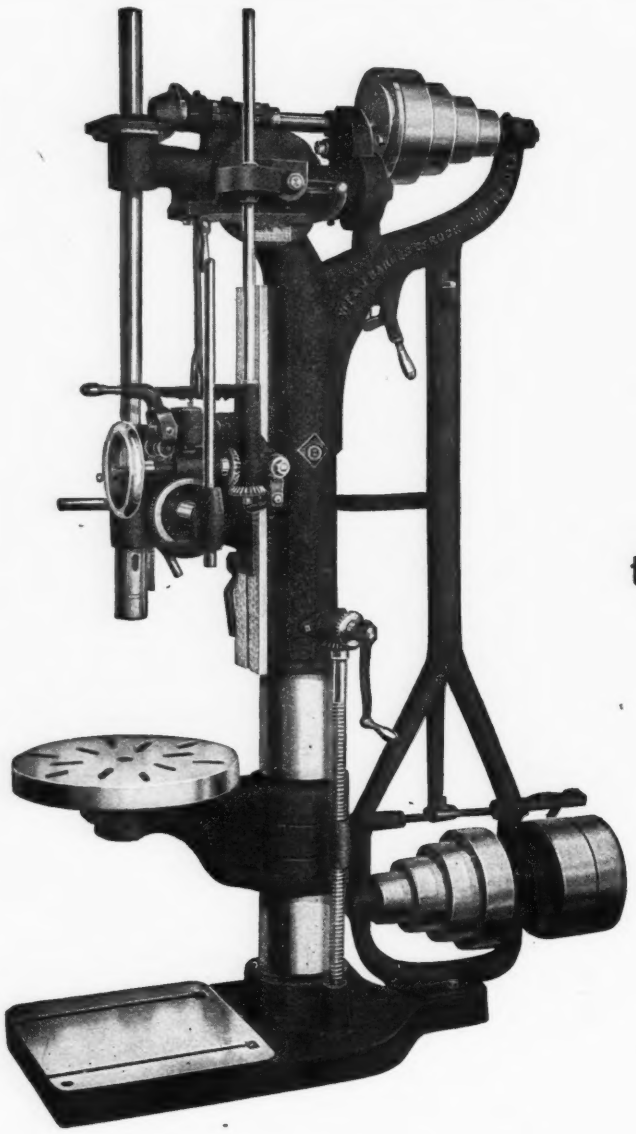
"This is caused by the compactness made possible by their use.

"In my judgment no new design should be made without considering the use of ball bearings.

"In a few years their use will be universal."

SKF BALL BEARING CO., Hartford, Conn.

The Barnes Drill



The Feed that "Makes 'em Talk"

BARNES No. 6, 22-IN. SWING DRILL

This cut represents our 22-inch Swing Drill, with sliding head, back geared, positive self feed and automatic stop, and quick return lever for spindles. Note this drill has also the plain lever and combined lever and wheel feed.

The *"Positive Self Feed"* gives eight changes of feed which adapt the drills for reamer work, drilling in steel or boring in cast iron. No belts to slip; no belts to throw off and on; all changes made by simple movement of a lever.

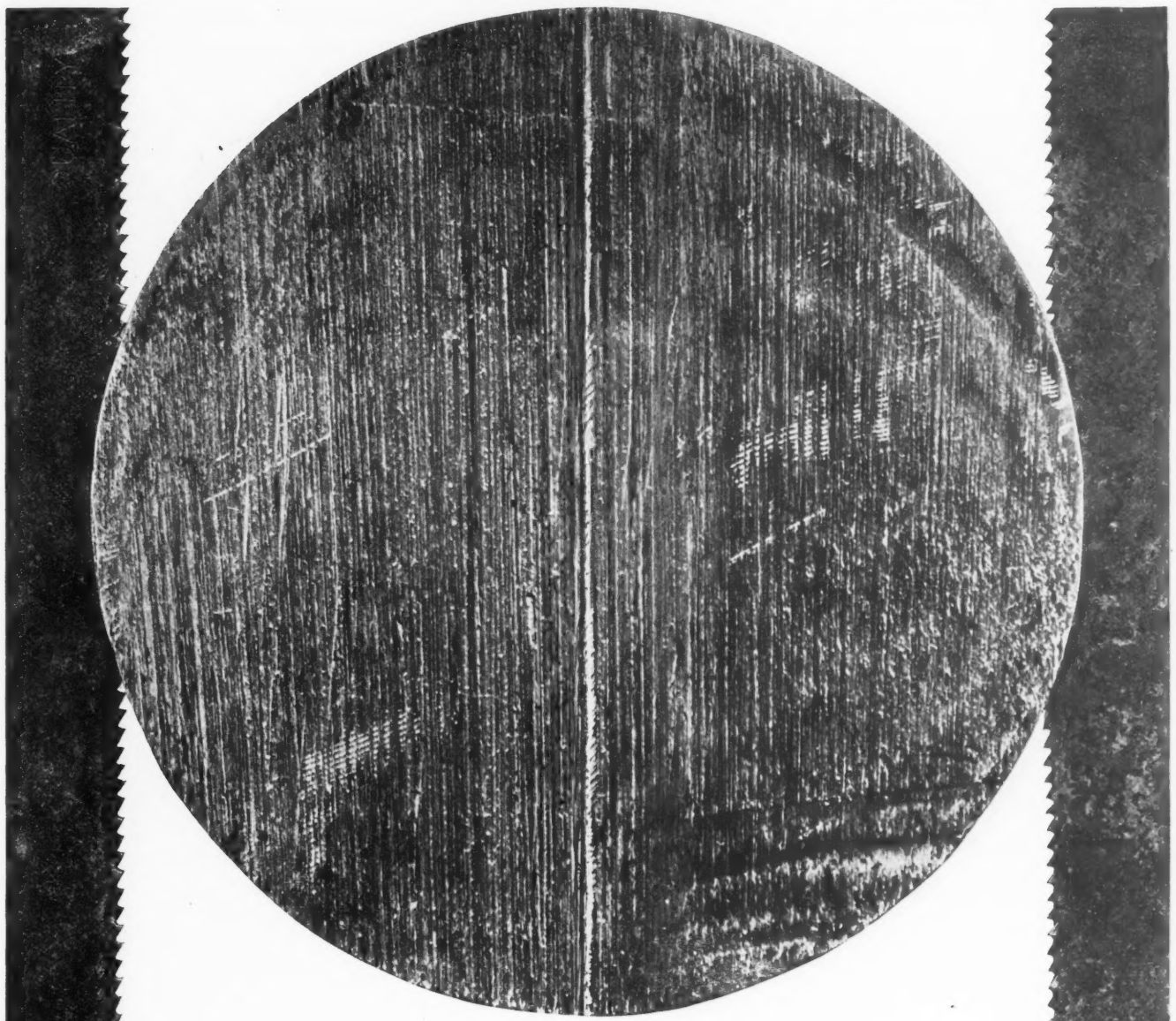
LOWER FEED—Our new lower feed mechanism (patented) gives universal control of drilling spindle. It gives operator choice of two automatic stops; therefore a combination which can either be set to disengage worm from worm gear, permitting the drill spindle to be quickly returned from drilling or reaming operations; or secondly, to disengage the miter feed gears, which stops the feed but leaves the worm and worm gear in mesh, as would be required in accurate facing and combination tool operations.

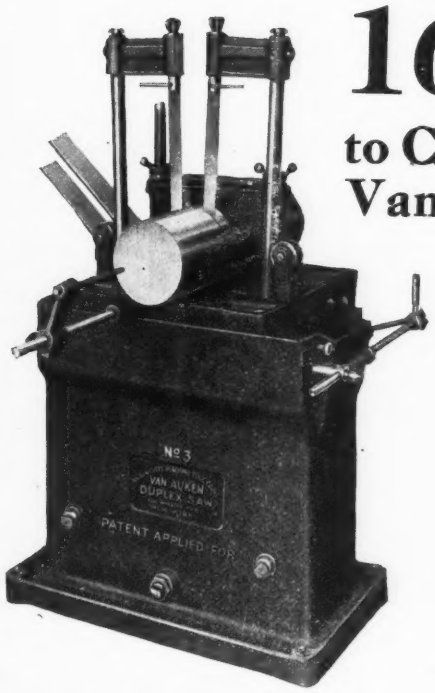
Complete line of Upright Drills from 8 to 50-inch swing—Gang Drills—Horizontal Radial Drills. Send for Catalog.

SOLE MANUFACTURERS ESTABLISHED 1872

W. F. & JOHN BARNES CO.

231 Ruby Street Rockford, Illinois





16 Minutes

to Cut this Steel Bar on the Van Auken Duplex Saw

This machine operates continuously, two cuts to every stroke, one up and one down—and it is fast, remarkably fast.

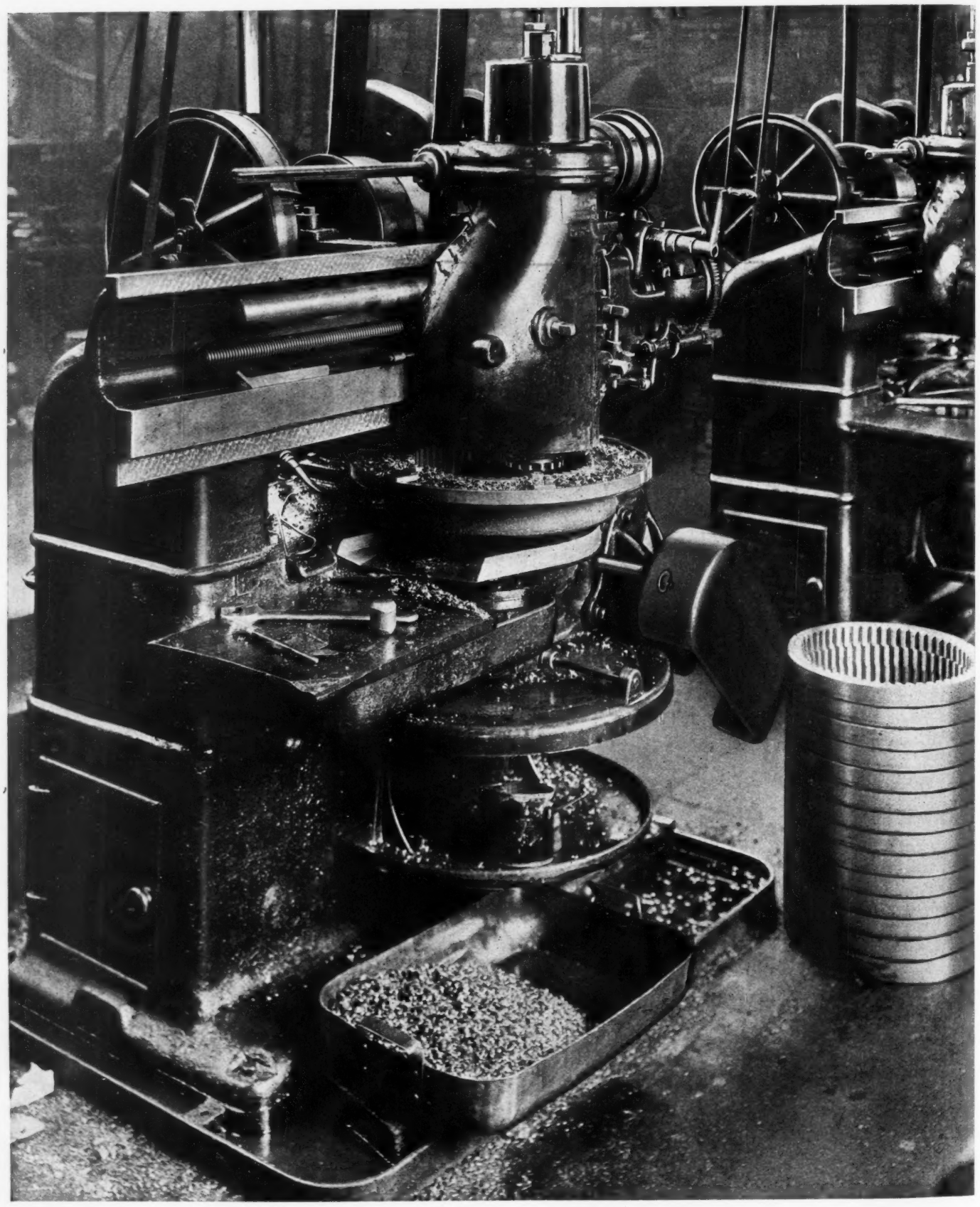
It combines every advantage of the ordinary hack saw—low first cost, low blade cost, little stock waste, simple construction—with production possibilities that can be equaled only by much more expensive machines and at much greater cost.

The advantages of the Van Auken Duplex Saw are readily demonstrated. May we show you?

COATS MACHINE TOOL CO., INC.

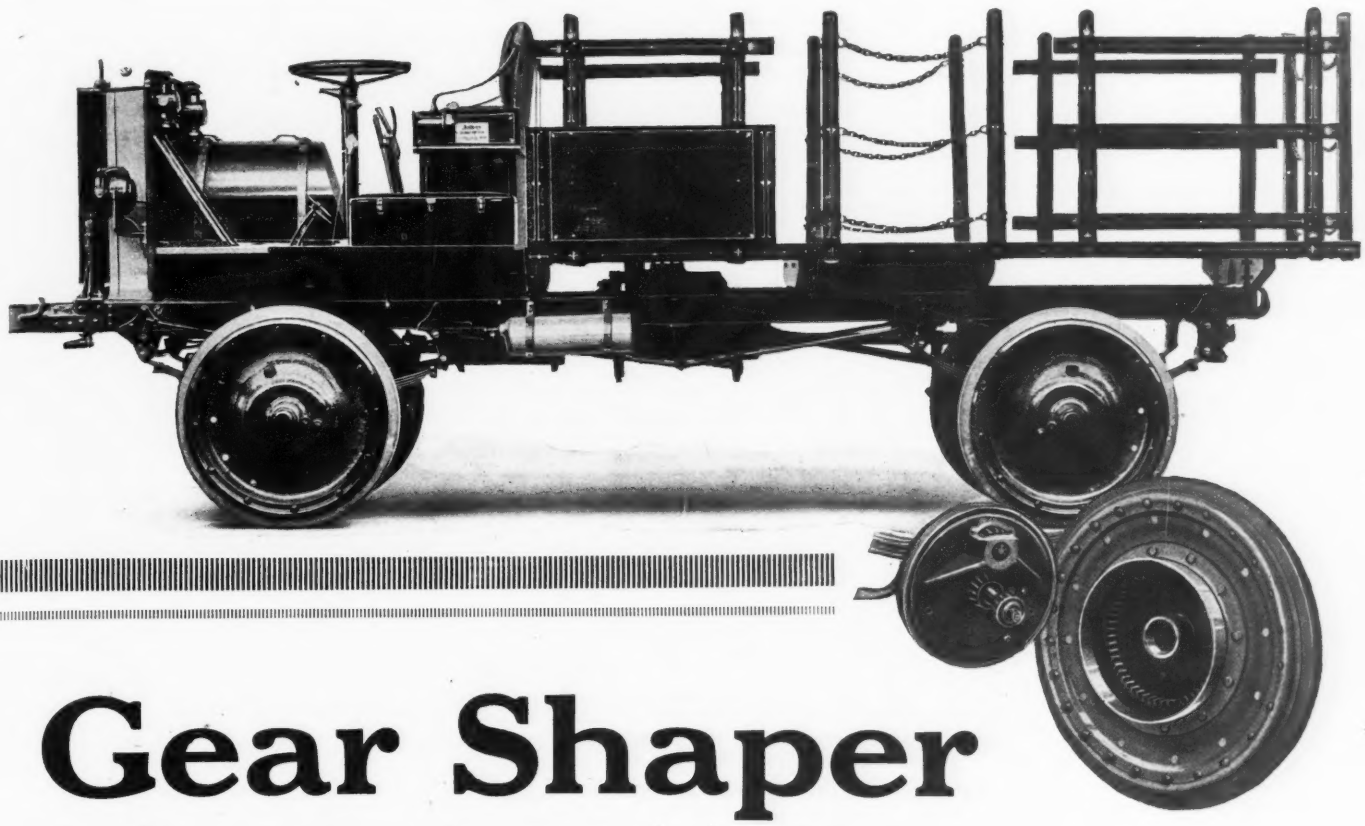
30 Church Street **New York, U. S. A.**

DOMESTIC AGENTS: For Wisconsin, Illinois and Iowa, R. R. Street & Co., Chicago, Ill. **FOREIGN AGENTS:** For Great Britain and Ireland, Coats Machine Tool Co., Ltd., Caxton House, London; 78 Vincent St., Glasgow; Goldsmith Hall, Pilgrim St., Newcastle-on-Tyne.



THE FELLOWS GEAR SHAPER

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry, England; Paris, France; Milan, Italy, and Spain; Yokohama, Japan; and Calcutta,



Gear Shaper

Jeffery Quad—Internal Drive

The Jeffery Quad is a wonderful truck, not because it drives, brakes and steers on all four wheels, but because of the wonderful things this method of construction makes possible. The Quad travels through mud, sand, snow and over hills where no other motor truck in the world can go. It is the truck selected for U. S. Army use. About 3,000 of them have been sold in the last two years—which is a record for any 2-ton truck of any one make.

The success of the Quad lies in the four-wheel drive. The success of the drive is due, to a large extent, to the large internal gears in each wheel—and these are machined on the Gear Shaper. In a catalogue description of this drive, the Jeffery Company says:

> "The extreme simplicity and ruggedness of the final drive in the Quad is plainly shown in this illustration. The large internal gear in the steel wheel of the truck should, barring unforeseen accidents, outlast any of the parts of the truck. The only other wearing parts in this construction are the bearings and the small spur pinion."

The illustration mentioned is shown above.

The Thomas B. Jeffery Company — Jeffery — Kenosha, Wis. U.S.A.

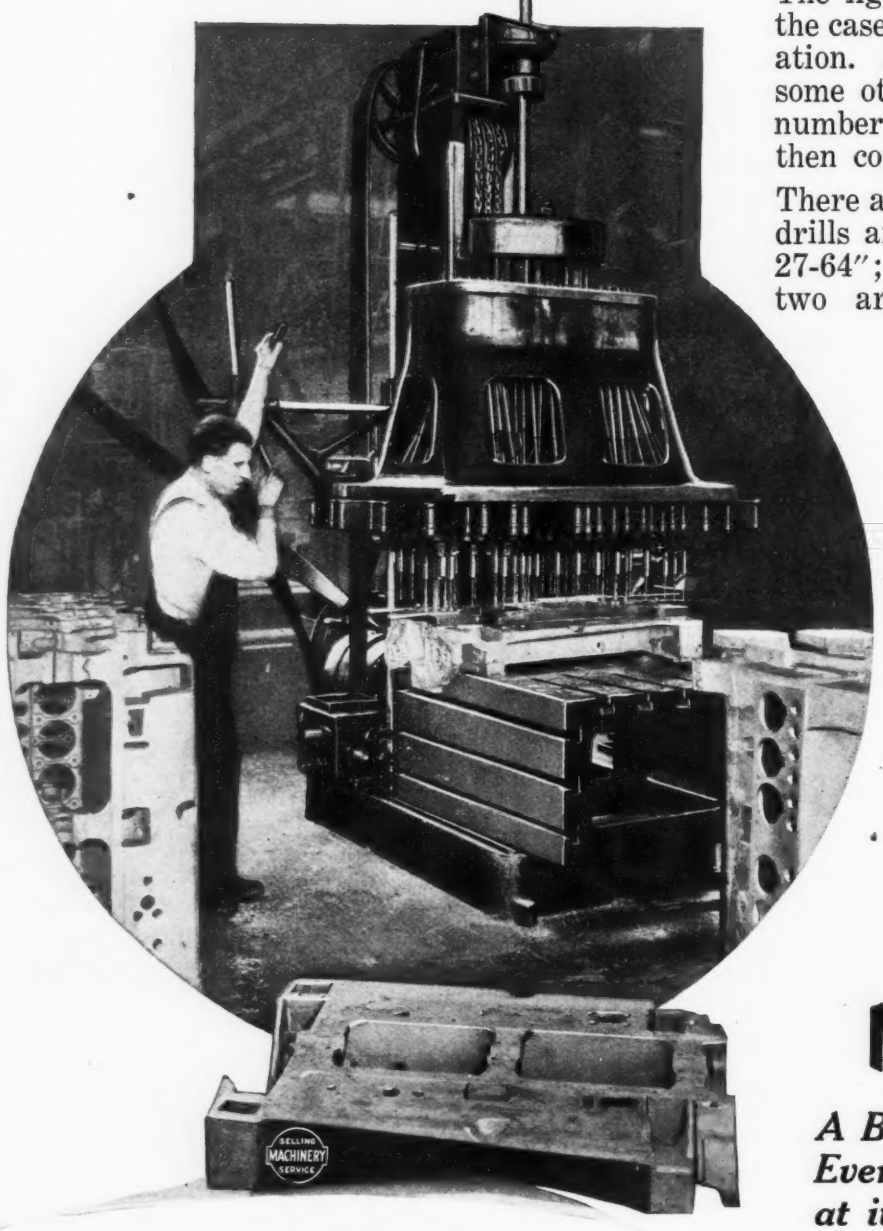
Cutting internal gears is one of the things the Gear Shaper does well and economically—and internal gears are growing in popularity for many purposes. May we tell you more about them—and the way the Gear Shaper produces them?

COMPANY, Springfield, Vermont

India: M. Koyemann, Dusseldorf, Germany, and Switzerland; White, Child & Beney, Vienna, Austria.

1 Machine—52 Spindles

1560 Holes per Hour



The figures tell the story in the case—and need no elaboration. Just try to figure out some other way to drill this number and range of holes, then compare production.

There are 52 spindles. Eight drills are 25-64″; twelve are 27-64″; thirty are 17-64″; two are 13-64″. Average production is 300 crank cases—15,600 holes—in ten hours.

Every NATCO drives different sizes of drills at their correct cutting speed. This, and this alone, makes it possible to secure the above output. If the small drills were compelled to be driven at the same speed as large ones (and this would be necessary if it were a single-speed-in-head machine (nothing like the quantity of work could be produced per day. This NATCO is one of the seven NATCO machines owned by the H. J. Walker Company, Cleveland, Ohio.

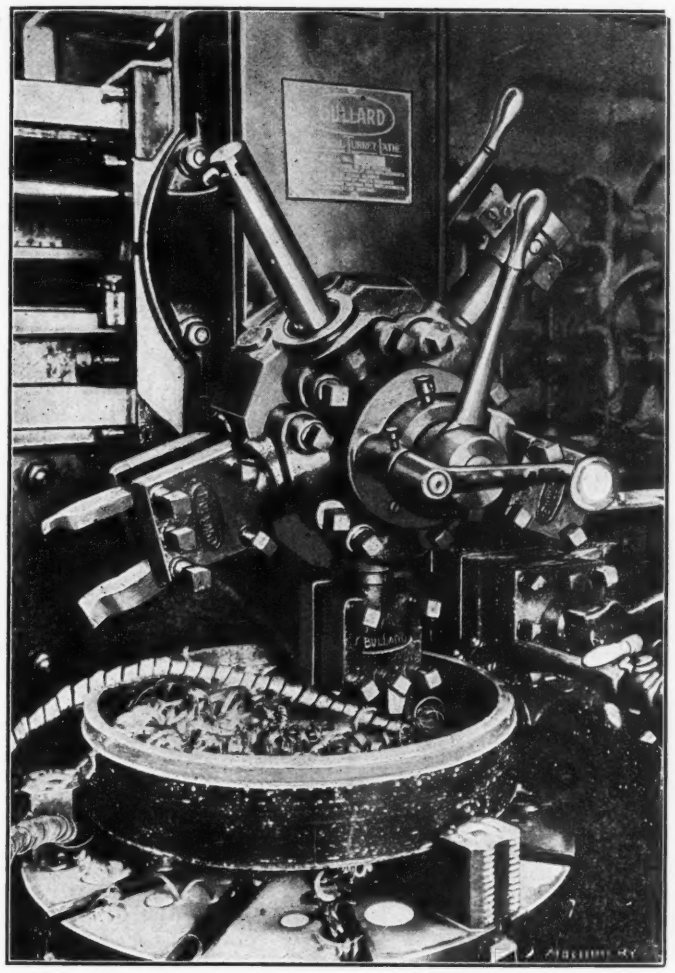
NATCO

A Big "Natco" and Every Drill is Driven at its Correct Speed

Tell us what you have in multiple drilling, reaming, tapping, counterboring and spotfacing, and we will tell you how to do it.

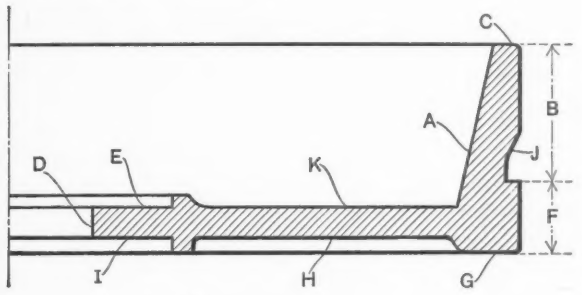
NATCO Drills range in size from 8″ round head with 8 spindles to 20 x 50″ head with 72 spindles and a capacity from 8—1/4″ to 16—1 1/4″ drills. Eleven sizes of standard vertical machines and a complete line of two-, three-, four- and five-way, both horizontal and vertical type.

The National Automatic Tool Co., RICHMOND INDIANA



Same Work, Same Tooling, Same Operator—but an Increase of 65% in Production

That is the story of the Bullard New Era Vertical Turret Lathe in the shops of the Pierce-Arrow Motor Car Company, Buffalo, N. Y. The photographs show the operations in machining steel fly-wheels, the blanks for which come to the lathe in a very rough turned condition, weighing 125 to 140 pounds each. In the first setting from 35 to 50 pounds of hard steel are removed in 46 minutes, including handling.



The Bullard New Era Vertical Turret Lathe

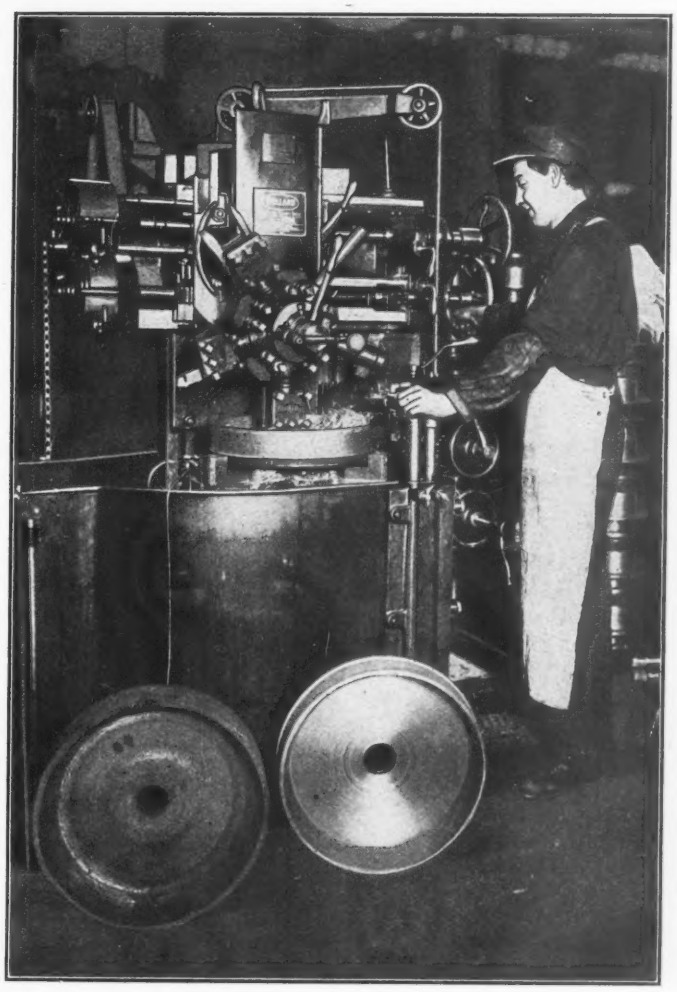
turns the bevel sides of 13 of these fly-wheels per day, an increase of 65 per cent over former production—and former production, 8 pieces per day, was good too, because it was Bullard production on an earlier model Vertical Turret Lathe.

The order of operations on this work is as follows:—

Bevel side uppermost. Rough turn outside diameter B to chuck jaws.
Rough face edge C. Rough bore angular face A.
Finish face web K. Bore D, and Counterbore E.
(Finish turn outside diameter F, B and groove J.) Finish edges C & G and angular face A.

It takes plenty of power to do this job—and stiffness to get the accuracy required. These are characteristic of Bullard tools, and *Convenience* is inherent.

The New Era Bullard is as far ahead of earlier Bullard models as these machines were ahead of other turning methods on many classes of work. Let us tell you more about it.



The BULLARD MACHINE TOOL CO.
BRIDGEPORT, CONN. UNITED STATES OF AMERICA

AMERICAN SWISS FILES

When you buy a file—buy as carefully as if it were a thousand dollar machine. Look for the trade mark. Look into its performances. Think about it—it will pay you.

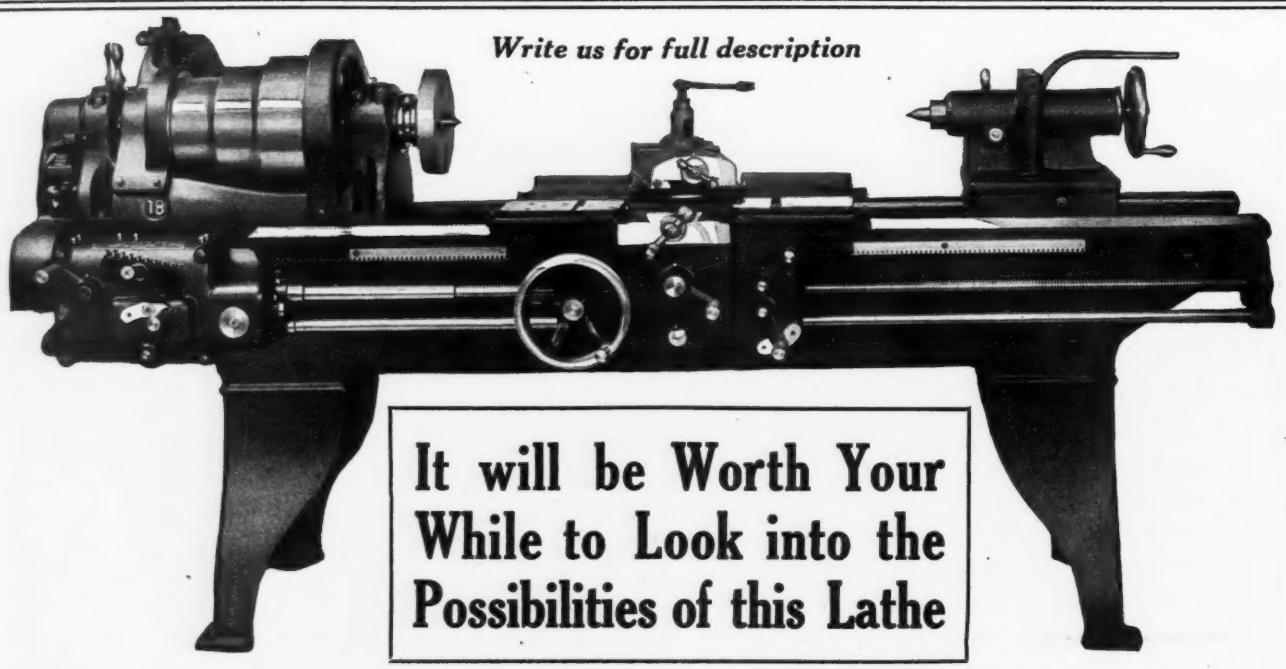
For fine work, for the finishing stroke, for a careful job—special or every day—the file with the **"American Swiss"** trade mark is the one you need. Be sure you get it.

FILES ONLY THE BEST ART GOOD ENOUGH TOOLS TRADE MARK

AMERICAN SWISS FILE & TOOL COMPANY

24 JOHN STREET, NEW YORK, U. S. A.

Write us for full description

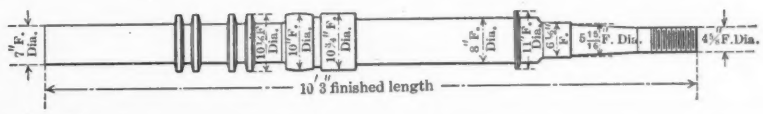


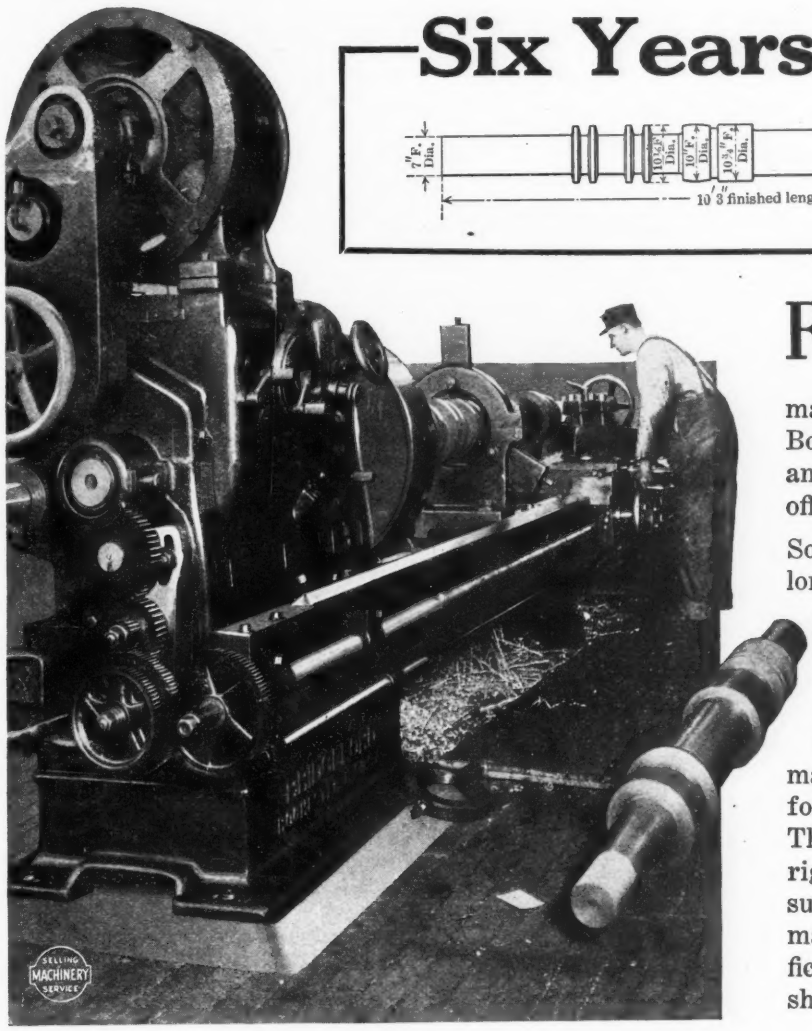
It will be Worth Your While to Look into the Possibilities of this Lathe

MORRIS Quick Change Engine Lathes have proved paying investments for shops that are using them. Better work and more of it—a wider range of possibilities has been realized in every case. Morris refinements in design are responsible. Some of the more important include: a patented quick change gear mechanism which gives 45 changes—range of threads 2 to 60; change gears to cut special pitches and metric threads; a patented one-piece apron, cast in box form, with all bearings integral; steel gears in apron with double bearings for shafts; feed frictions operated by single lever and an interlocking device which prevents thread and feed mechanisms engaging at once.

MORRIS MACHINE TOOL CO., Cincinnati, O.

Six Years of This



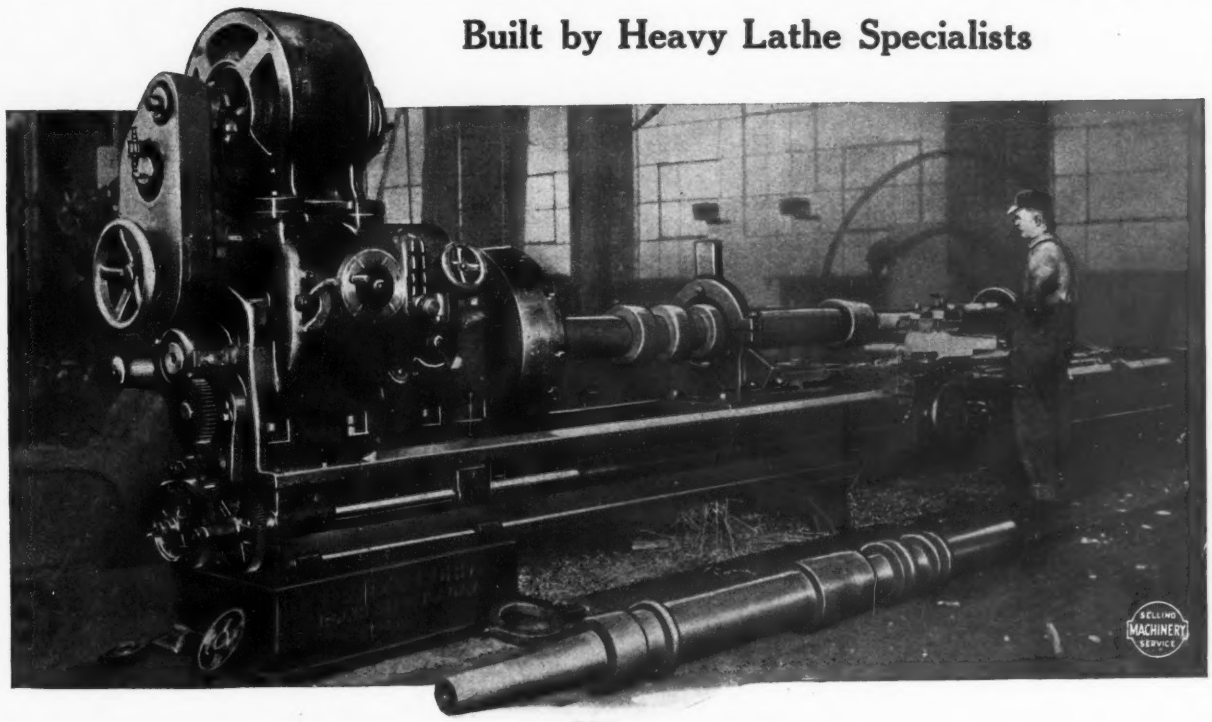


FOR SIX YEARS this Bridgeford Lathe has been turning shafts and other big brick-making machinery parts for The Bonnot Company, Canton, Ohio—and its newness hasn't even worn off.

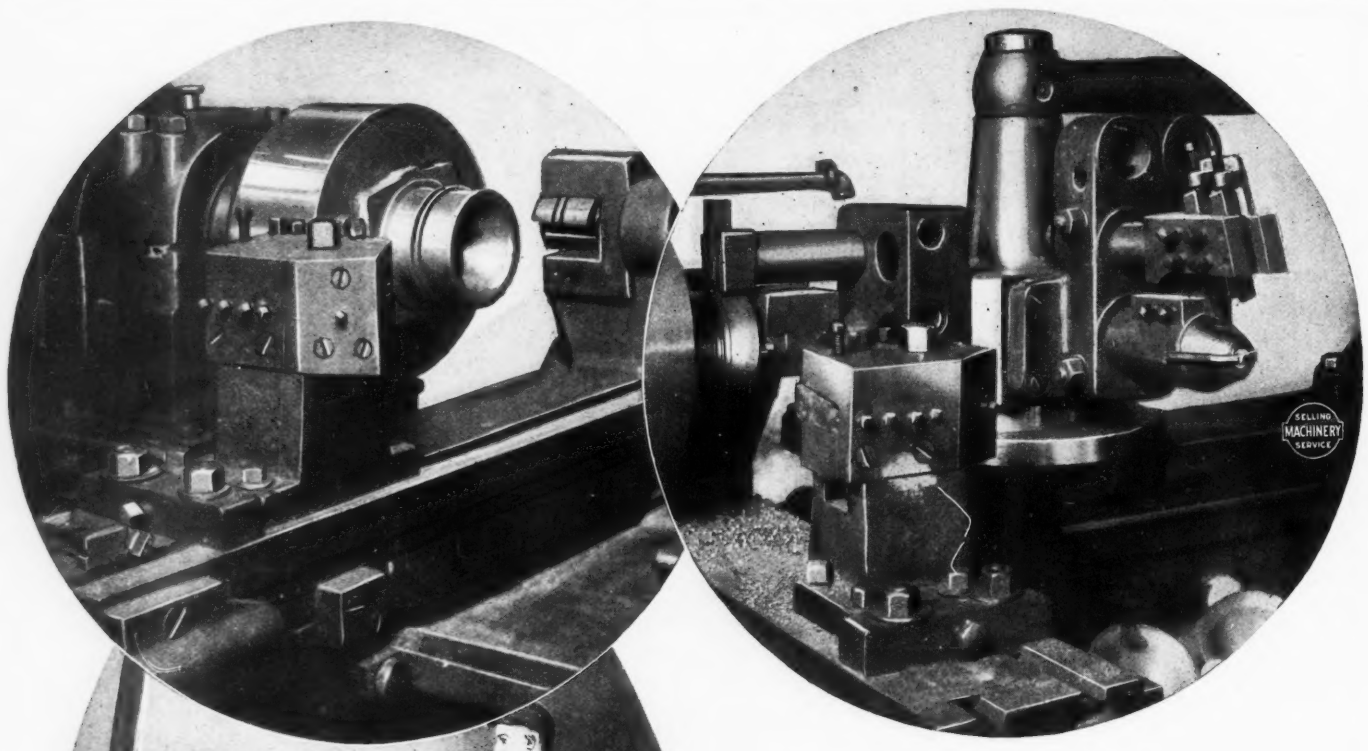
Some of this work is 26½ feet long; some of it smaller. The piece shown is machined all over and threaded, ¾" stock being removed, to limits of plus or minus 0.0015", in a total of 22 hours—and this is but one of many good examples of Bridgeford production in this plant. There's power and strength and rigidity in any Bridgeford Lathe sufficient to perform any work, no matter how heavy, in the most efficient manner. We'll be glad to show you.

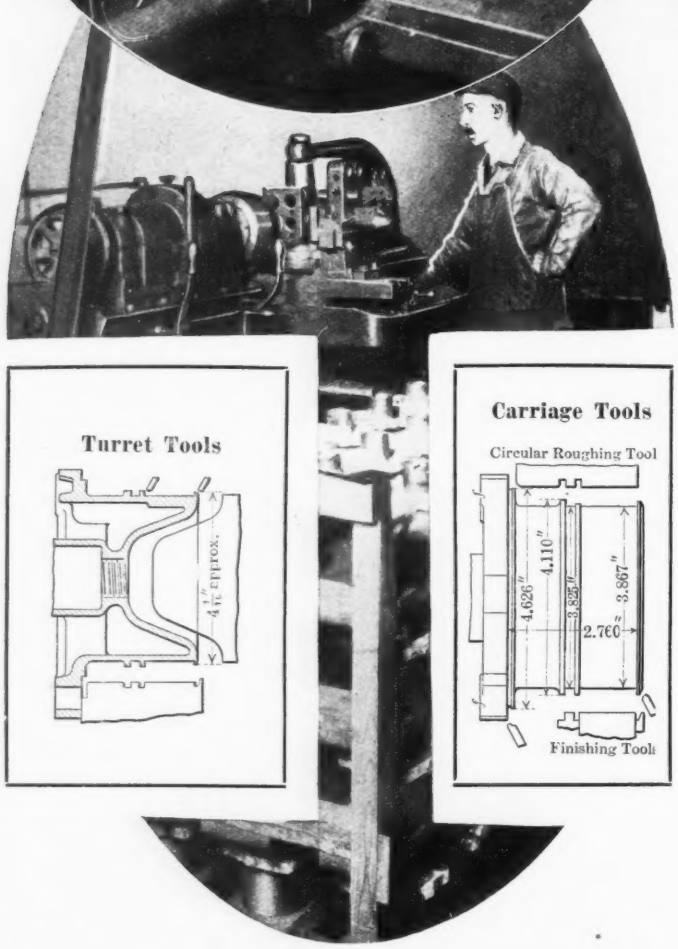
The BRIDGEFORD Lathe

Built by Heavy Lathe Specialists



BRIDGEFORD MACHINE TOOL WORKS, 235 Mill Street, Rochester, N. Y.





Potter & Johnston
Manufacturing Automatic

Do It Automatically When You Can

These cylinder heads for Willys-Knight motors were formerly tooled up on hand turret machines—and production per machine was 15 a day (10 hours).

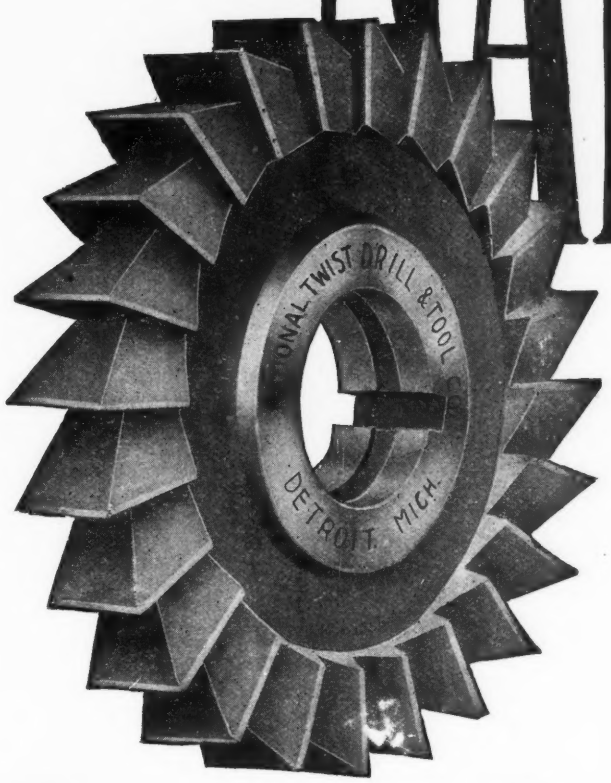
They are now machined on Potter & Johnston Manufacturing Automatics at the rate of 70 per day, each machine. Note the tool set-ups in the accompanying sketches—interesting, aren't they?

We'll be glad to furnish production estimates on any of your work adapted to automatic manufacture—to show you in more detail the reasons why your choice of automatics should be Potter & Johnstons. Write us.

POTTER & JOHNSTON, Pawtucket, R.I., U.S.A.

OFFICES AND REPRESENTATIVES: Office for Great Britain and France: 68 Avenue de la Grand Armee, Paris, J. Ryan, Manager. New York Office: Fulton Bldg., 50 Church St., Walter H. Foster Co., Managers. Detroit Office: Modern Machinery and Engineering Co., 1514 Ford Bldg. Chicago Office: 4213 Sheridan Road, Chas. H. Shaw, Manager. Toronto Office: 1501 Royal Bank Bldg., E. C. Roelofson, Manager. **FOREIGN AGENTS:** Chas. Churchill & Co., Ltd., London, Birmingham, Manchester and Newcastle-on-Tyne, England, and Glasgow, Scotland. Schuchardt & Schutte, Berlin, Vienna, Stockholm, Copenhagen and Budapest. Ercole Vaghi, Corso Porta, Nouva 34, Milan, Italy.

NATIONAL

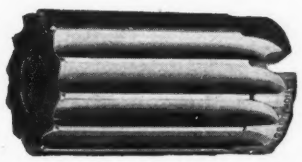


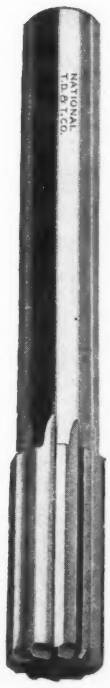
If neither cost nor quality counts in selecting tools, one tool is as good as another. But to the man who discriminates there is no tool like a "National" for producing quality work at low cost. "National" Twist Drills, Reamers, Cutters, etc., are specified by the wide-awake shop manager because they have repeatedly proved their economy and cutting efficiency. High-grade steel, correct cutting clearance and uniform temper give "National" tools their work-producing qualities. Extreme care and rigid inspection guarantee this kind of service from every tool we ship.

The "National" line is complete.

Arbors, Bits, Chucks, Countersinks, Counterbores, Cutters, Twist Drills, Reamers, Mandrels, Mills, etc.

All styles and sizes.





Our catalogue should be on your desk for constant reference.

National Twist Drill & Tool Company

DETROIT MICHIGAN, U. S. A.

117 to 119 Leonard St., New York, N. Y.
104 South Jefferson St., Chicago, Ill.

Touchin' On and Appertainin' to a $1,000-

Beware of Entrance to a quarrel, but being in,
Bear't that the opposed may beware of thee.

—HAMLET, Act I, Scene III.

THE "CHALLENGE"

"..... Tool Holders were awarded The Grand Prize for Tool Holders at the Panama-Pacific Exposition under and in strict accordance with the official 'Rules and Regulations Governing the System of Awards' under which our exhibit was **entered.** This was and is the First and Only Grand Prize for Tool Holders **so** awarded. We are prepared to Prove this statement of fact and have deposited One Thousand Dollars, etc.," the balance of the "challenge" consisting of provision for a stakeholder, a jury, their inevitable expenses, and a beneficiary of award!

THE FACTS IN THE CASE

As the word "so" is the "53rd card" in this "challenge" and the word "entered" (instead of "re-entered") the 54th, the italics are ours. The "Rules and Regulations" read: "There shall be but one Grand Prize in each class." The class in which we and the "challengers" entered our exhibits and competed did not provide for a Grand Prize Award, the two highest awards to be competed for having been explained to us and to the jury beforehand as follows:

"The following scale of markings shall be used in determining the final merits of an exhibit and fixing the award that should be made, 100 being used as indicating perfection.

"Exhibits receiving markings ranging from 85 to 94, inclusive—Gold Medal.

"Exhibits receiving markings ranging from 95 to 100, inclusive—Medal of Honor."

The jury for Group 90 which passed upon these particular exhibits was composed of the following gentlemen:

Mr. George W. Dickie, Consulting Engineer, San Francisco, Cal., Chairman; Mr. J. C. Mengel, Master Mechanic, Pennsylvania R. R. Co., Altoona Shops, Altoona, Pa., Vice-Chairman; Mr. D. S. Watkins, Asst. Supt. of Shops, Southern Pacific Railroad, Sacramento, Cal.; Prof. John T. Faig, Head of Dept. of Mechanical Engineering, University of Cincinnati; Mr. William H. Crosby, President, The Crosby Company, Manufacturers of Sheet Metal Stampings, Buffalo, N. Y.; Mr. F. J. Frank, Secretary of "Iron Age," New York City.

This jury was the **only jury that visited both booths,** or was charged with the duty of inspecting exhibits in our classification. Their decision in every essential part is quoted herewith from a letter written by their Chairman, Mr. Dickie, to the President of the Superior Jury:

"In Group 90 there were two exhibits by Competing Exhibitors which received especial and careful consideration at the hands of the jury: I refer to that of Williams & Co. and that of ..... Co., both of which firms are prominent in their lines of work. After a careful general examination of these exhibits by the Group Jury, a special Report was made by Mr. J. C. Mengel, Vice-Chairman of the Jury, Master Mechanic Pennsylvania Railroad Company, with headquarters in the Altoona Shops, and Mr. D. S. Watkins, Assistant Superintendent of Shops, Southern Pacific Company, Sacramento, Cal. The Reports of these jurors are attached to the questionnaires submitted with my Report.

"The Report on the Williams Co. Exhibit is as follows:
"'..... Well worthy of the Medal of Honor award recommended.'

"The report on the ..... Co. exhibit is as follows:
"'..... The award of a Gold Medal recommended is in line with the character of the exhibit and the reputation of the machines and tools.'

"The awards recommended by the jury on Group 90 for these two exhibits were carefully reviewed by the jury for Department F, of which I was Chairman, and the recommendation of the Group Jury was unanimously confirmed.

"A protest against the award was made by the ..... Company which was submitted to the Committee on Protests and Appeals and appears in the Report of that Committee dated June 21st, 1915, No. 36, and is as follows: 'The protest of the ..... Tool Company was carefully considered by our Sub-Committee who could find no reason to recommend any change from the Gold Medal recommended by the Department Jury.' "

Lest it be further claimed that our Tool Holders were "carried along" by our other goods, we quote the following from the same letter:

"The Group Jury laid special stress on the superior character of the tool holders exhibited by the Williams Company; in fact it was this superiority which in the opinion of the jury placed their exhibit above that of the ..... Co."

About four months afterward, however, and after the Inspecting and Visiting Juries (the only juries which were composed largely of men of mechanical experience) had completed their work and had been discharged, the appeal was carried still further until the Superior Jury, unknown to us, created a special class not in the original competition, and without inviting us or, as we believe, other Tool Holder manufacturers to compete, or even reviewing our Exhibit, awarded A Grand Prize for tool holders alone to the "challengers," thus conferring a higher award upon a class in which there was only **one entrant** than upon the one in which all similar exhibitors had competed, and also upon one of the very articles upon which our company had previously been declared the winner of "The Highest Award"! If others competed why was there no second, third or fourth prize in **this** class as provided in "The Rules and Regulations"?

Of course, the inconsistency of this result, effectually reversing the combined judgments of the Visiting Jury, the Jury for Department F and the Committee on Protests and Appeals, was soon recognized, with the result that our award including tool holders was raised to that of Grand Prize, as the only adjustment then possible. This is indicated by the following letter from the Secretary of the Superior Jury, under date of Nov. 12, 1915, the emphasized words being ours:

"Messrs. J. H. Williams & Co.,
Brooklyn, New York.

"Gentlemen:

"This is to notify you officially that the Superior Jury, after due consideration, has awarded you a Grand Prize, which is the highest award that can be conferred by the jury.

"This Grand Prize applies to the entire line which you have exhibited here and which was entered on your questionnaire, **and to each part thereof.** Thus you are entitled to claim a highest award on wrenches, or vises, or crankshafts, or tool holders, or on any of the special forgings which you have exhibited.

"It is but fair to inform you, however, that an award of Grand Prize on tool holders alone and specifically has been made to another firm at this exposition, and that said firm is entitled to claim a highest award on tool holders **equally with you.** In the case of said firm, however, the remainder of its line has been granted a lower award than that of Grand Prize.

"From the above you will readily see the latitude which is allowed you in whatever claim you may make, and also just what limitations might be imposed thereon.

Very truly yours,
(Signed) O. H. FERNBACH,
Secretary of the Superior Jury."

An official letter, to substantially the same effect, from the same gentleman (the official spokesman of the Jury) was given to the "challengers" at the same time, which would have confirmed the above mentioned equality of tool holder award if it had been published with the "challenge"!

In view of the above we repeat herewith the only important claims we have publicly made with reference to our San Francisco award insofar as tool holders are concerned since the award became final:

1. "Williams' 'Agrippa' Tool Holders were the only Tool Holders recommended for 'The Highest Award' on the specific ground of superiority."

2. "Williams' 'Agrippa' Tool Holders were **specifically** mentioned in the Grand Prize Award conferred upon them."

3. "The first year that a Grand Prize was ever given for tool holders at an International Exposition was the first time that Williams' 'Agrippa' Tool Holders competed."

4. "Williams' 'Agrippa' Tool Holders won 'The Highest Award' first and last."

J. H. WILLIAMS & CO., Brooklyn, N. Y.

One Thousand Dollar Challenge!—$1,000!

Of (Doubtful) Interest to Tool Holder Users in general, though apparently Vital to one "Challenger" in particular. The Remarkable Public Reception of WILLIAMS' "Agrippa" Tool Holders is Uniquely Reflected!

As the only *other* winner of the Grand Prize Award for Tool Holders, we are indirectly invited by conspicuous advertisement to deposit **$1,000—One Thousand Dollars—$1,000** in an effort to prove:

(1) that a worthy competitor came by a quite justified award at the Panama-Pacific International Exposition in a manner contrary to the "Rules and Regulations Governing the System of Awards" or

(2) that our own Grand Prize Award (of equal value as to Tool Holders and superior as to all other articles exhibited in common) is *not* tainted with the tint of Technicality!

It is distinctly distasteful to us publicly to dispute the regularity of a competitor's success, and we will have none of it—especially when one's feeling is rather that of congratulation upon a recognition well earned by years of undoubted success in Accomplishment, Product and High Character of business dealings.

We recognize no necessity to justify the technical propriety of our own Award, given as it was by the Superior Jury, and signed by the President and Secretary thereof and by the President of the Exposition.

Because, however, of the publicity given this "Challenge," following the frequent public attempts to create the impression that our award **in respect to Tool Holders** was based upon our other products, and was in reality inferior to our "challenger's" award, we finally feel obliged to publish on the opposite page the facts in the matter, content to let readers (if any are sufficiently interested) judge for themselves as to the moderate character of our previous public claims.

We do this, neither claiming superiority nor admitting inferiority of Award, and if in stating the facts necessary to disprove the limitations cast upon our own award, the inference of comparative reference becomes unavoidable, it is with more sincere regret that our efforts to avoid a trade paper controversy (by agreement upon the basis of equal recognition) repeatedly made since the awards became final, have failed.

With this statement the matter is closed so far as this company is concerned; we have not asked for affidavits or testimonials of any kind nor shall we do so; they are easily obtained by anyone if wanted sufficiently. We have, however, ample evidence to support every public statement we have made and shall be only too pleased to show it to our "challengers" at our office—without asking them to deposit **$1,000—One Thousand Dollars—$1,000.**

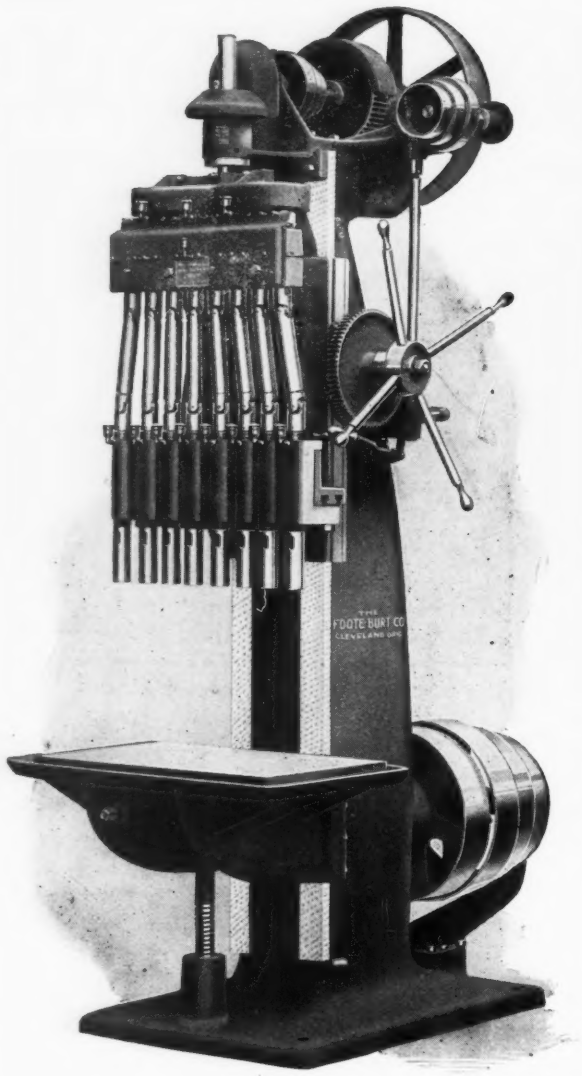
In our opinion the importance of the subject is greatly over-estimated—the defense of honest advertising is the only issue that justifies reply.

Meanwhile, Williams' "Agrippa" Tool Holders, despite their youth, are daily winning The Grandest Prize of all in the shops all over the world, while their makers are too busily engaged in extending this service to regret or dispute the technicalities of their competitors' legitimate successes.

The Winners of "The Highest Award" at the Panama-Pacific International Exposition.

The Winners of "The Highest Award at the Panama-Pacific International Exposition.

"THE HOLDERS THAT HOLD"



A Machine Developed Especially for Valve Hole Work

We developed this No. 15½ Eight Spindle Adjustable Drilling Machine for valve hole operations in automobile cylinder castings and for other work on which a machine with spindles adjustable in a straight line only can be used.

The spindles are adjustable up to a minimum center distance of 2⅛″ and are arranged with No. 4 Morse Taper. Length of power feed is 12″. Table working surface is 18″ x 30″. Size of special Ball Joint is 1¾″. Machine is arranged with friction throw-out back gear and six changes of speed and feed.

It is a highly profitable tool on all work within its range. Let us send the bulletin.

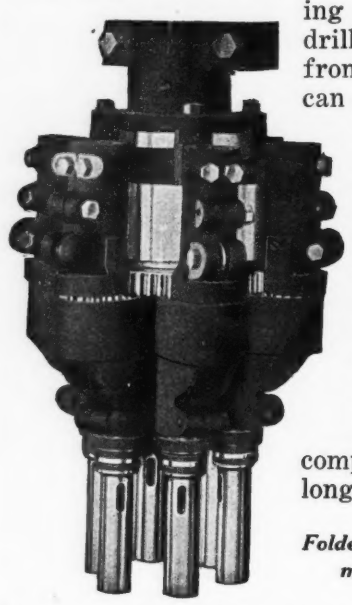
THE FOOTE-BURT COMPANY
CLEVELAND, OHIO

MILWAUKEE OFFICE, 436 Wells Building.
DETROIT OFFICE, 806-8 David Whitney Building.

FOREIGN AGENTS: Buck & Hickman, Ltd., London, Birmingham, Manchester and Glasgow. Moscow Tool & Engine Co., Moscow. Ing. Ercole Vaghi, Milan. R. S. Stokvis & Zonen, Ltd., Rotterdam. R. S. Stokvis & Fils, Brussels. Heinrich Dreyer, Berlin. Glaenzer & Perreaud, Paris, agents for France, Switzerland, Spain and Portugal. Benson Bros., Ltd., Sydney, Australia, agents for Australia and New Zealand. Mitsui & Co., agents for Japan, Korea and Manchuria. Wilh. Sonesson & Co., Ltd., Malmo, Sweden and Copenhagen, Denmark.

Increase Drilling Output

This No. 3 Covington Adjustable Multiple Drill Head, intended for use on 20 to 36-inch upright drills or on large radial drills, insures production limited only by the working capacity of the drill itself. It carries from 2 to 8 spindles, can be quickly attached, and handles layouts of varied descriptions. Spindle adjustments are simple and absolutely immovable under most severe strains.

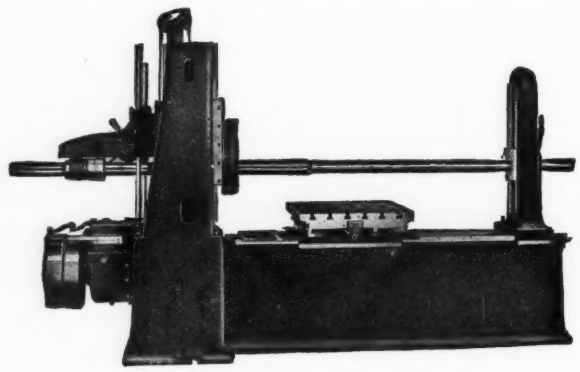


The Covington Head is small, compact and built for long, hard service.

Folder with more information on request

Covington Multiple Drill Company
Fifth and Scott Sts. Covington, Ky.

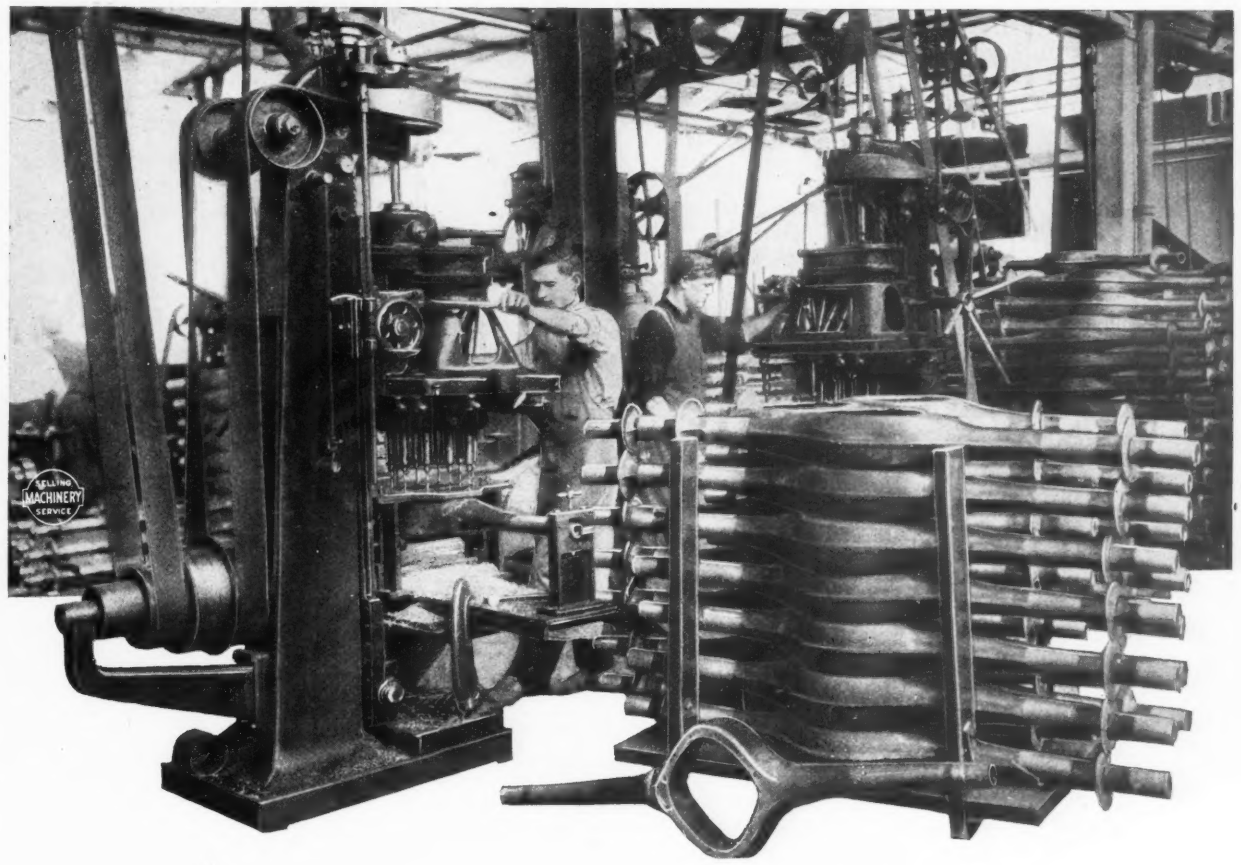
UNIVERSAL
(HORIZONTAL)
BORING MACHINE



Says one of our customers: "The Universal (Horizontal) Boring Machine is the foundation of our business. The accuracy of our own machines is insured by the accuracy of the Universal."

"Where Quality Counts, We Win"

Universal Boring Machine Co.
HUDSON, MASS., U. S. A.



230

Rear Axle Housings Per Day

or

$2\frac{6}{10}$ Minutes Each

on a

FOX

MULTIPLE DRILL

THOUSANDS of holes in hundreds of rear axle housings in one 10-hour day on one machine! The machine, the Fox Multiple; the plant, that of the Weston-Mott Company, manufacturers of automobile parts, at Flint, Michigan, or any other shop where Fox machines do the drilling.

In this particular case 12 holes 5-16″ diameter are drilled on each side of each housing. 12 spindles are in operation drilling 12 holes at a time. Production is 230 housings or 5520 holes per 10-hour day, per machine. As there are two "Foxes" on this work, total output per day is 11,040 holes. The only break in drilling is the time required to load and unload the table and turn the work for the second operation.

Fox production is fast; Fox output is accurate; Fox costs are low. Fox machines are built for service and give it. Centralized controls; independent speed and feed changes; as few or as many spindles in operation as desired; other advantages. Send for the catalogue.

FOX MACHINE COMPANY

1401 W. Ganson Street, JACKSON, MICHIGAN

NEW YORK OFFICE: 30 CHURCH STREET

"Sammy Showme"

Investigator of

Simonds Saws

THE QUEST OF
SAMMY SHOWME
SIMONDS INVESTIGATOR
IN 12 REELS
REEL N°1

THIS is "SAMMY SHOWME."

He's in search of the best in metal sawing practice, the country over.

What he finds he'll tell you on this page every month.

Keep your eye on "SAMMY."

Simonds Manufacturing Company

"The Saw Makers" Established 1832

FITCHBURG, MASSACHUSETTS

17th St. and Western Ave., Chicago, Ill.
St. Remi Street, Montreal, Que.
90 West Broadway, New York City.
Memphis, Tenn. New Orleans, La. San Francisco, Cal.
Portland, Ore. Seattle, Wash. Vancouver, B. C.
St. John, N. B.

ARE YOU HAVING TROUBLE IN GETTING ENOUGH

FILES
DRILLS
TAPS AND DIES
REAMERS
MACHINISTS' TOOLS
AND
BOLTS
SCREWS
NUTS
ETC., ETC.

?

We don't claim we can take care of all comers but we do claim an exceptionally large stock of these staples (all catalogued in our 1100 Page Book No. 62) and invite your inquiries.

Many of the largest concerns in the United States have found us very handy during the last 6 months.

Why not you?

HAMMACHER, SCHLEMMER & CO.

HARDWARE, TOOLS AND SUPPLIES

4th Avenue and 13th Street **New York, Since 1848**

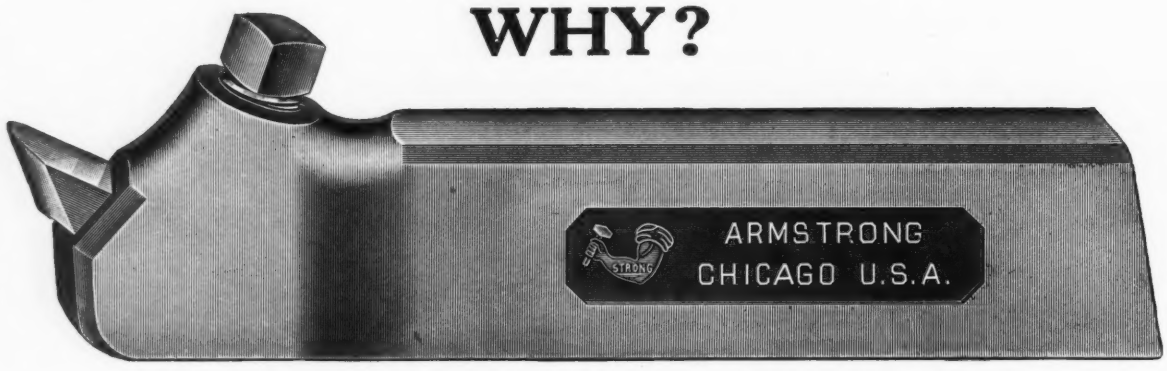
THE GRAND PRIZE WINNER
AT THE PANAMA-PACIFIC EXPOSITION

ARMSTRONG TOOL HOLDERS

THEY ALWAYS MAKE GOOD

For 25 Years **they have been in competition with every Tool Holder ever designed throughout the world and today there are ten times as many of them in use as all others combined.**

WHY?



$1,000.00 CHALLENGE!

Armstrong Tool Holders were awarded **The Grand Prize for Tool Holders** at the Panama-Pacific Exposition under and in strict accordance with the Official "Rules and Regulations Governing the System of Awards" under which our exhibit was entered. This was and is the **First** and **Only** Grand Prize for Tool Holders so awarded. We are prepared to **Prove** this statement of fact and have deposited **One Thousand Dollars** with the Union Trust Company of Chicago under an agreement whereby said $1,000 will be forfeited and paid over to The American Red Cross if we fail to prove the above statement, upon condition only that the party questioning the above statement shall also deposit $1,000 to be forfeited to The American Red Cross if we prove the above statement to the satisfaction of a Jury composed of former exhibitors at the Panama-Pacific Exposition—the Winner and Loser to each pay half of the Jury's expenses.

This challenge is open to any and all and remains open until August 15, 1916.

ARMSTRONG BROS. TOOL COMPANY

313 N. FRANCISCO AVE. *"The Tool Holder People"* CHICAGO, U. S. A.

OTHER TOOLS WE MAKE: Ratchet Drills, "C" Clamps, Drilling Vises, Lathe Dogs, Automatic Drill Drifts, Lathe Tool Posts, Planer Jacks, Drilling Posts, Wrenches, etc.

AJAX

(Trade Mark Registered)

Taper Forging Rolls

THESE ROLLS are being widely used for producing tapered forgings.

The surface of the pieces can be made smooth and uniform.

They can be produced more rapidly and economically than with hammers, and the expense of repairing damaged hammers is eliminated.

It is impossible to give any complete list of parts or of shops where these rolls might be used. They are successfully employed in hundreds of plants.

If you use tapered forgings at all like those shown, write for an Ajax Engineer. He will tell you whether the rolls will do the work and just what the production would be.

Tapered Tubes

Many manufacturers will see how the tapering of this class of work can be applied to their products.

Brake Shoe Keys

The enormous savings which it was possible to make by the use of the roll method led us to design a special machine for making these brake keys complete, all in one heat and at a single handling.

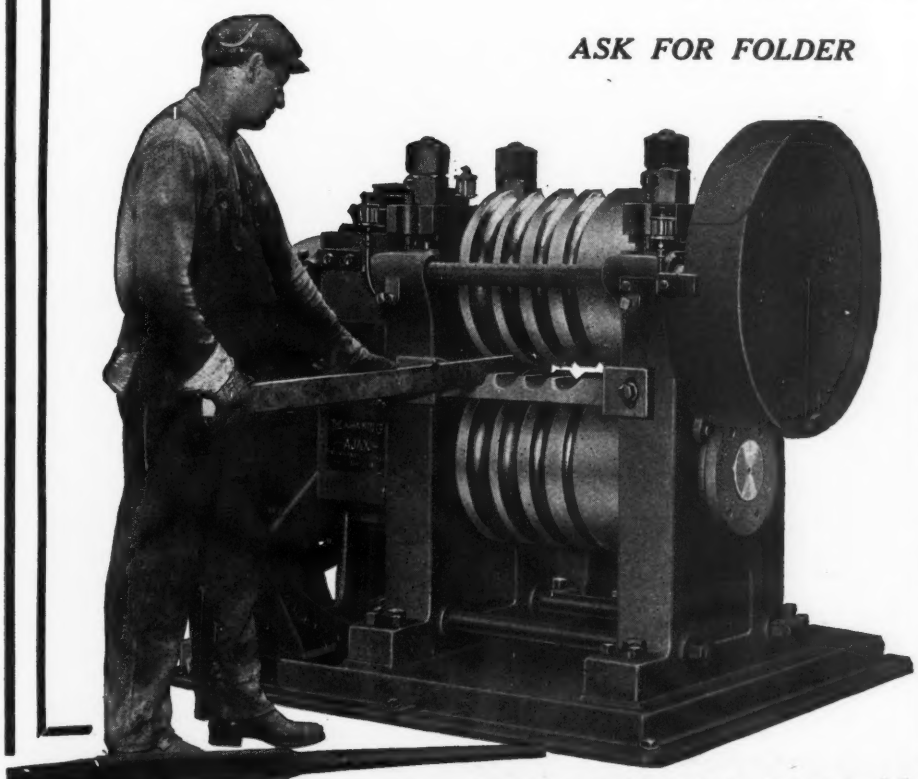
Wedges

In making such pieces, the uniformity of taper and the great speed of the Ajax Rolls give the most satisfactory and economical production possible.

Tongs

These illustrations show the uniform taper and smooth work done on Ajax Machines.

ASK FOR FOLDER



THE AJAX MFG. CO.

CLEVELAND, OHIO

CHICAGO OFFICE:
621 Marquette Building

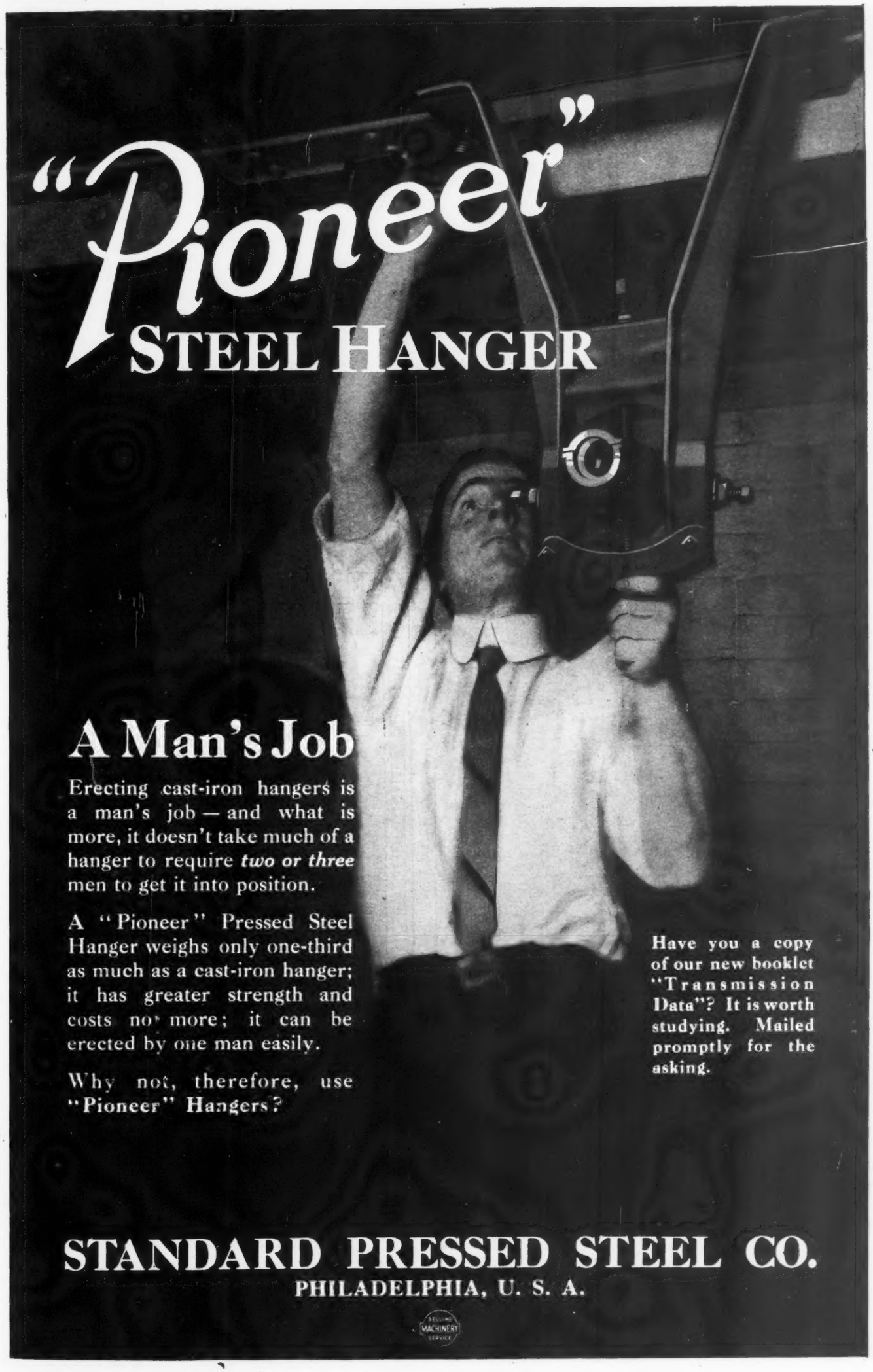
NEW YORK OFFICE:
1369 Hudson Terminal

ONE of our advertisers recently suggested changing the name "MACHINERY'S Selling Service" to "Selling Machinery" Service. He said it would fit as well and mean more—and we think he really meant it.

There's a difference in the two expressions; but the real meaning is the same. MACHINERY'S Selling Service was originated to help sell machinery, machine tools and accessories—and as a service for selling machinery it has been highly successful. But it is MACHINERY'S Service also, conceived by MACHINERY and developed by MACHINERY to the point where it now takes care of the advertising of some forty-odd concerns—and we shall continue to call it MACHINERY'S Selling Service.

Run through the advertisements carrying the Service Mark in this copy of MACHINERY—then ask us to tell you how *you* can use the Selling Service to advantage.

MACHINERY, New York



A Man's Job

Erecting cast-iron hangers is a man's job — and what is more, it doesn't take much of a hanger to require *two or three* men to get it into position.

A "Pioneer" Pressed Steel Hanger weighs only one-third as much as a cast-iron hanger; it has greater strength and costs no more; it can be erected by one man easily.

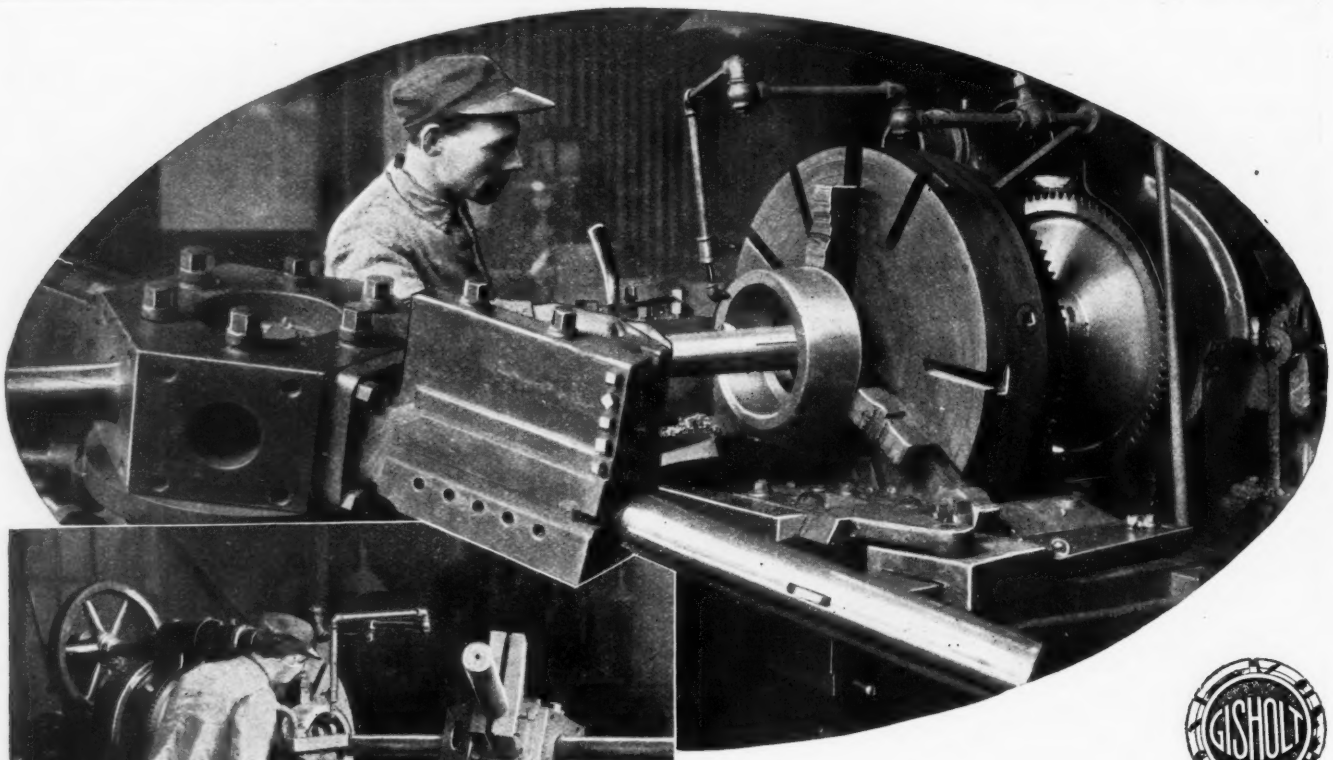
Why not, therefore, use "Pioneer" Hangers?

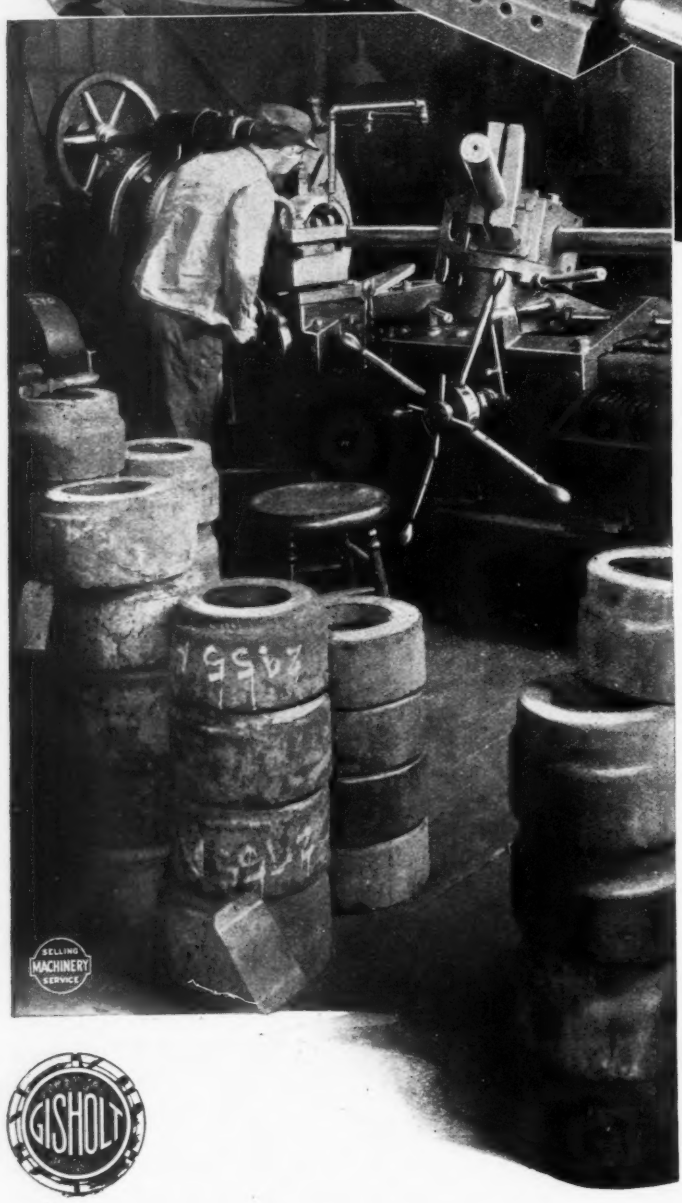
Have you a copy of our new booklet "Transmission Data"? It is worth studying. Mailed promptly for the asking.

STANDARD PRESSED STEEL CO.

PHILADELPHIA, U. S. A.

SELLING MACHINERY SERVICE





GISHOLT

GISHOLT MACHINE COMPANY

1117 E. Washington Avenue
MADISON WISCONSIN

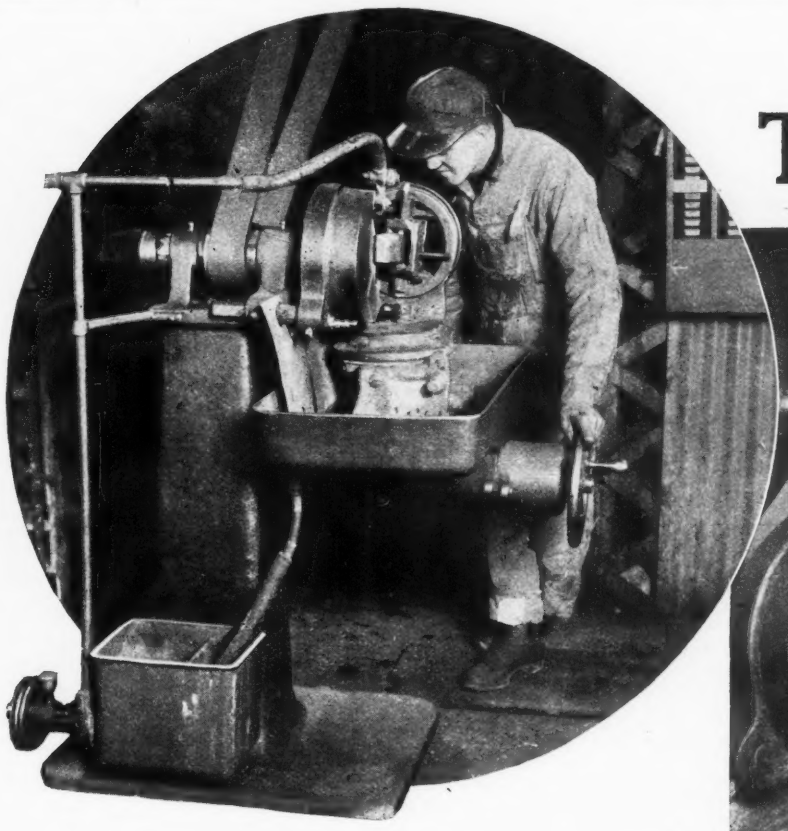
A Demonstration of GISHOLT Serviceability

Here's a Gisholt Standard Turret Lathe which has been plugging away on heavy locomotive crane parts for sixteen years—and it runs like a top today.

You can see it for yourself if you'll "drop in" at the plant of the Browning Engineering Company, Collinwood, Ohio. These people are "Gisholt" enthusiasts—they tell things about "Gisholt" serviceability which are interesting, to say the least.

The work shown is a cast steel clutch ring; 1/4" to 1/2" stock removed; both turret and carriage used simultaneously. First operation; face end, bore, turn O. D. 9 3/4". Second operation; turn oil groove 5/8" wide, 8" diameter. Third operation; rechuck and turn balance of O. D., face end, 8 3/4" diameter. Time, first operation, 40 minutes; second, 20 minutes—total 1 hour, from floor to floor.

We claim there's no machine can beat a "Gisholt" for work of this character. Want us to prove it?



Better Tool Grinding

It is Possible to Grind a Tool Correctly by Hand; But Why make your High Priced Mechanics Do It?

Tool grinding the "Gisholt" way is the correct way—every tool ground to its correct angles and re-sharpened by *grinding the top only.* No guess work about it—the angles are standard, sample tools are furnished for the operator to duplicate and a chart is provided which shows him exactly how to obtain each angle.

The "Gisholt" way is the way of the Browning Engineering Company, Cleveland, Ohio. One Gisholt Tool Grinder and one man grind the tools for the whole shop. Each man has a sharp tool ready and waiting for the moment he needs it.

No machine is held up while its operator is off in some other part of the shop grinding (or waiting his turn to grind) the tool he needs.

Not only is production bettered; but costs are reduced. Tool costs are less; labor is less; waste time is less.

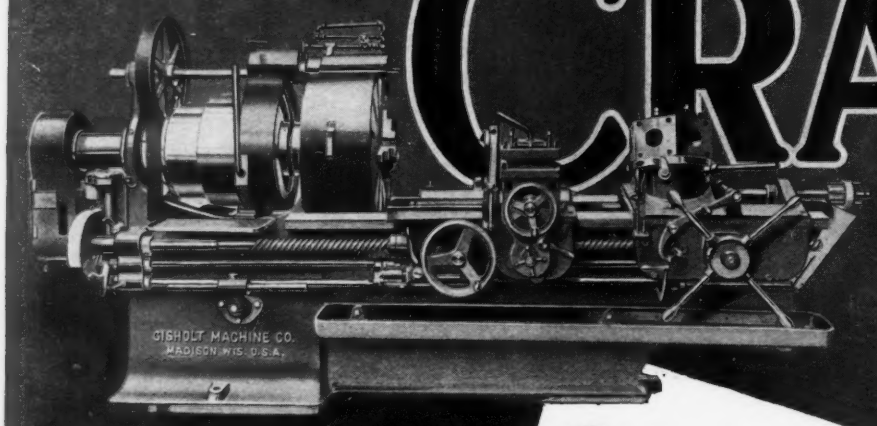
All these advantages and more we offer you in the Gisholt Tool Grinder. May we send the catalogue and more details ?

GISHOLT

GISHOLT MACHINE COMPANY

1117 E. Washington Avenue
MADISON WISCONSIN

CRAMP Metals Used by



Gisholt Lathe made by the Gisholt Machine Co. manufacturers of one of the best turret lathes in the world.

Gisholt Machine Company

General Offices Madison Wis
Works Madison Wis Warren Pa

Engineers
Manufacturers
Madison, Wis. U. S. A.

Cable Address: Gisholt Madison
Codes: Liebers ABC 4th Ed Gisholt

The William Cramp & Sons Ship & Engine Building Co.,
Philadelphia, Pa.

March 21st, 1916.

Gentlemen:

Mr. W. P. Smith,
Superintendent of Sales.

Your letter of March 14th received. The photograph showing our turret lathe, being photo 1298-A, also a photograph showing the Feed Box Pinions made of Parsons' Manganese Bronze, are being sent you today.

Three sizes of these pinions are shown in the photograph simply to illustrate the different sizes that we make of your bronze. Only one of these pinions is used in any machine and is placed in the feed box at the left end of the turret lathe.

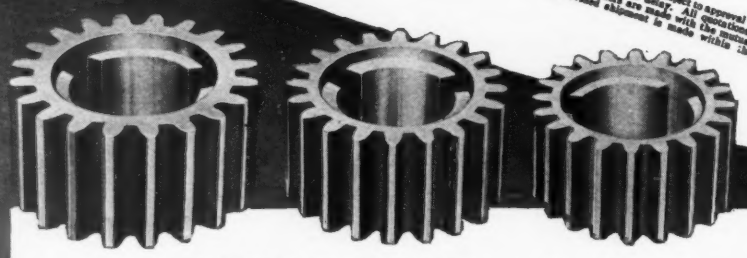
Parsons' Manganese Bronze is used in these gears owing to the strength and hard work required.

Yours very truly,

GISHOLT MACHINE COMPANY

RJW-GSP
Enc.

All orders and contracts solicited by any Representative of this Company are subject to approval by it at Home Office. All orders and contracts accepted subject to labor difficulties, fire or other unavoidable delay. All quotations subject to change without notice. All our proposals, quotations and acceptances of orders are made with the mutual understanding that orders are not subject to cancellation provided shipment is made within the time promised.

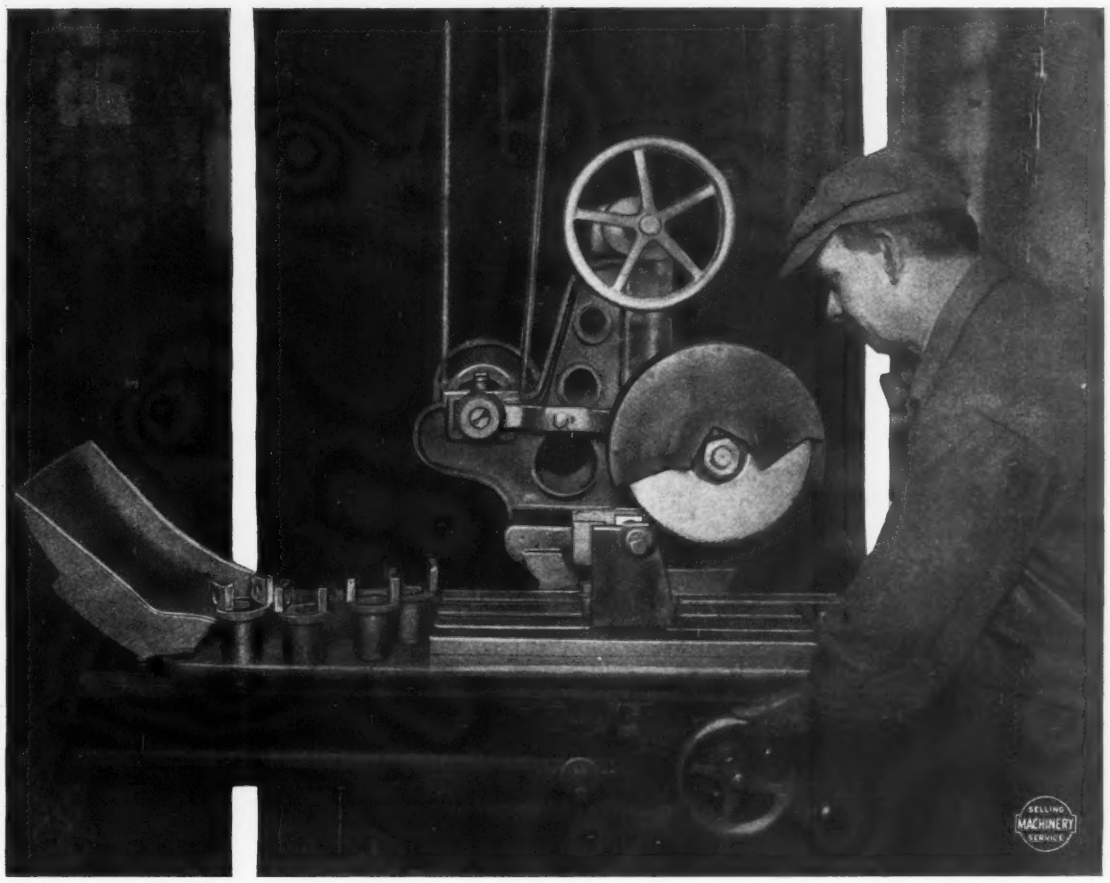


Feed Box Pinions of Parsons' Manganese Bronze.

Machinery builders of recognized ability in designing and manufacturing machine tools of the highest quality, invariably use CRAMP METALS. Lathes built by the Gisholt Machine Company have feed-box pinions made of Parsons' Manganese Bronze. The use of this metal, by these World-Famous Lathe Builders, is a fitting tribute to its strength and wearing qualities. One hundred years' experience as machinists and metallurgists enables us to offer practical suggestions of great importance to you. Write us for information in regard to your needs.

THE WILLIAM CRAMP & SONS SHIP & ENGINE BUILDING COMPANY, Philadelphia

Diamond Surface Grinder



Universal Joint Grinding
By the International Motor Co.

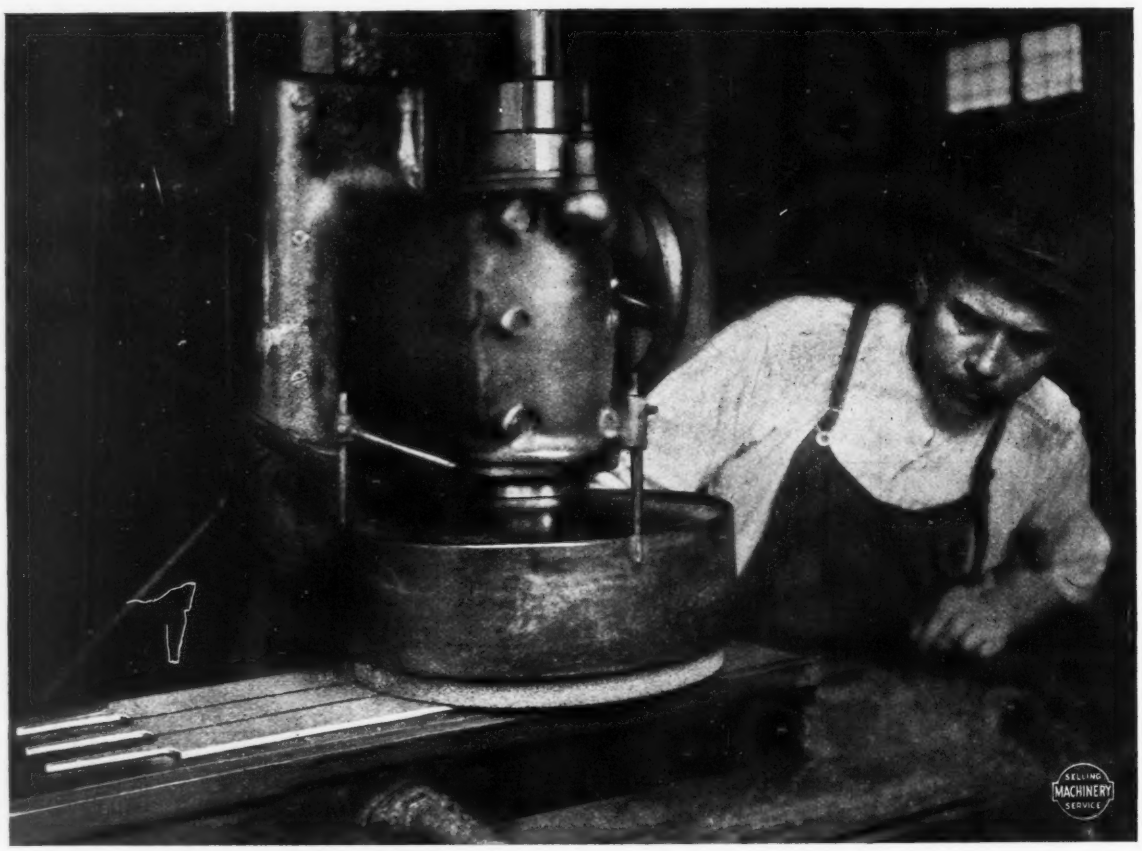
The Diamond Surface Grinder at the Plainfield, N. J., plant of the International Motor Company is a busy machine. It grinds everything that can be put up to a machine of this type; it has been in service for five years, and it has yet to be out of commission for repairs. The job on hand when our photographer called was grinding nickel-steel universal joints, taking 0.020″ of stock from the slot and finishing the bottom at the same time. Not spectacular grinding by any means, but owing to the toughness of the material and the accurate finish required, a pretty good indication of how the Diamond Grinder meets demands on a really stiff job.

Diamond Surface Grinders are made right, and every machine subjected to rigid test before it leaves the factory. Add to "Diamond" accuracy and speed, "Diamond" ability to take such cuts as 0.006″ on hardened steel and 0.125″ on cast iron, and you have "Some Grinder."

Let us show you some before-and-after production figures.

DIAMOND MACHINE COMPANY, Providence, R. I.

AMERICAN GRINDING WHEELS



And They Continue To Use Them Year After Year

In the whole convincing record of American Grinding Wheel efficiency, there is no more important data than that secured recently at the Elizabethport (N. J.) plant of the American Swiss File & Tool Company. This concern makes a high-grade line of files and employs in every department the best equipment obtainable.

They began using American Grinding Wheels five years ago, and have continued them because they proved absolutely satisfactory for the exacting work demanded. The photograph shows an "American" grinding 12″ x 2″ flat file blanks three at a time. The files are ground first on one side, then turned and ground on the other. The American wheel is 12″ diameter, 4½″ high, cup shaped, grain 46 corundum, grade 1¼—a grade which has proved a winner from the first.

That's American history—the wheel that suits the work today can be duplicated next year—or the year after. American Wheels are adaptable—none more so. They are quality wheels—none better. Used exclusively by many firms who say they have "tried them all." Write us your requirements. We have the wheel.

AMERICAN EMERY WHEEL WORKS

PROVIDENCE, RHODE ISLAND

Buck & Hickman, Ltd., London, Sheffield, Birmingham, Manchester, Glasgow; F. G. Kretschmer & Co., Frankfurt, a/M., Germany; Heinrich Dreyer, Berlin, Germany; Hans Schulze, Vienna, Austria; Kann & Heller, Budapest, Hungary; A. B. V. Lowener, Stockholm, Sweden; V. Lowener, Copenhagen, Denmark; V. Lowener's Maskinforretning, Sverre Mohn, Christiania, Norway; R. S. Stokvis & Zonen, Ltd., Rotterdam, Holland; R. S. Stokvis & Fils, Paris, France, and Brussels, Belgium; Takata & Co., Tokio, Japan; Societa Italiana De Fries & Co., Milan, Italy; La Maquinaria Anglo-Americana, R. D'Aulignac, Barcelona, Spain; Bevan & Edwards Pty., Ltd., Melbourne, Australia; O. R. San Galli, Petrograd, Russia; Murphy & Charles, Inc., Valparaiso, Chile (for Chile, Peru and Bolivia).

Grinding A Pump Casting All Over in Three Operations

Out in Plainfield, N. J., the International Motor Company finds big possibilities in Gardner Disc Grinders. One interesting and profitable application is grinding castings as shown below. This bronze casting, an impeller for a water pump, is finished complete in three quick operations. In the first operation the casting is held in a special fixture and rotated at right angles to the disc. This finishes the periphery and brings the diameter to size. The two subsequent operations face the sides of the impeller at the proper angles, the casting being held in the same fixture. The casting is thus finished smoothly and uniformly all over. One-sixteenth of an inch or more is removed at each operation. Production is very satisfactory—30 or more wheels being finished easily within an hour.

Isn't it logical to assume that the Gardner Grinder can do similar work in your shop? Why do work on a milling machine or lathe when a "Gardner" will finish it better in a fraction of the time?

We can cite hundreds of cases where this machine has effected genuine savings. Write us to-day for details.

The

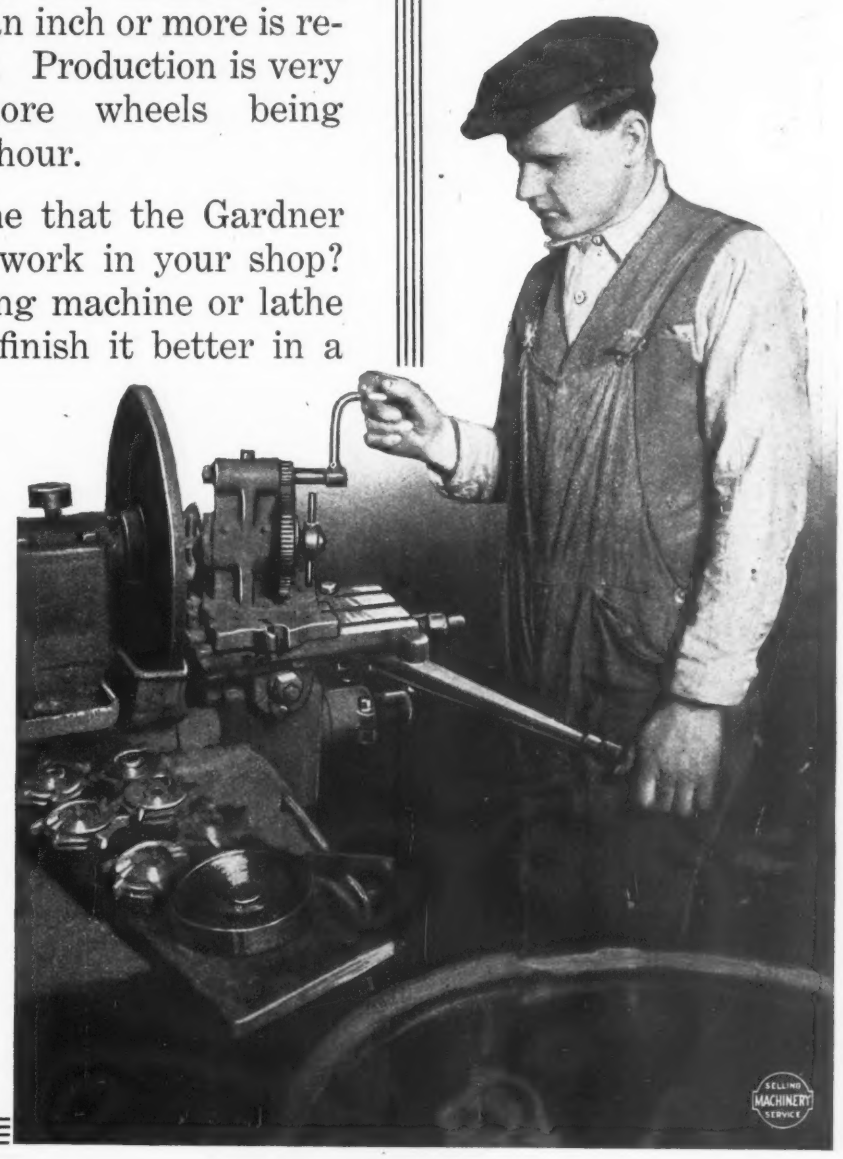
GARDNER MACHINE COMPANY

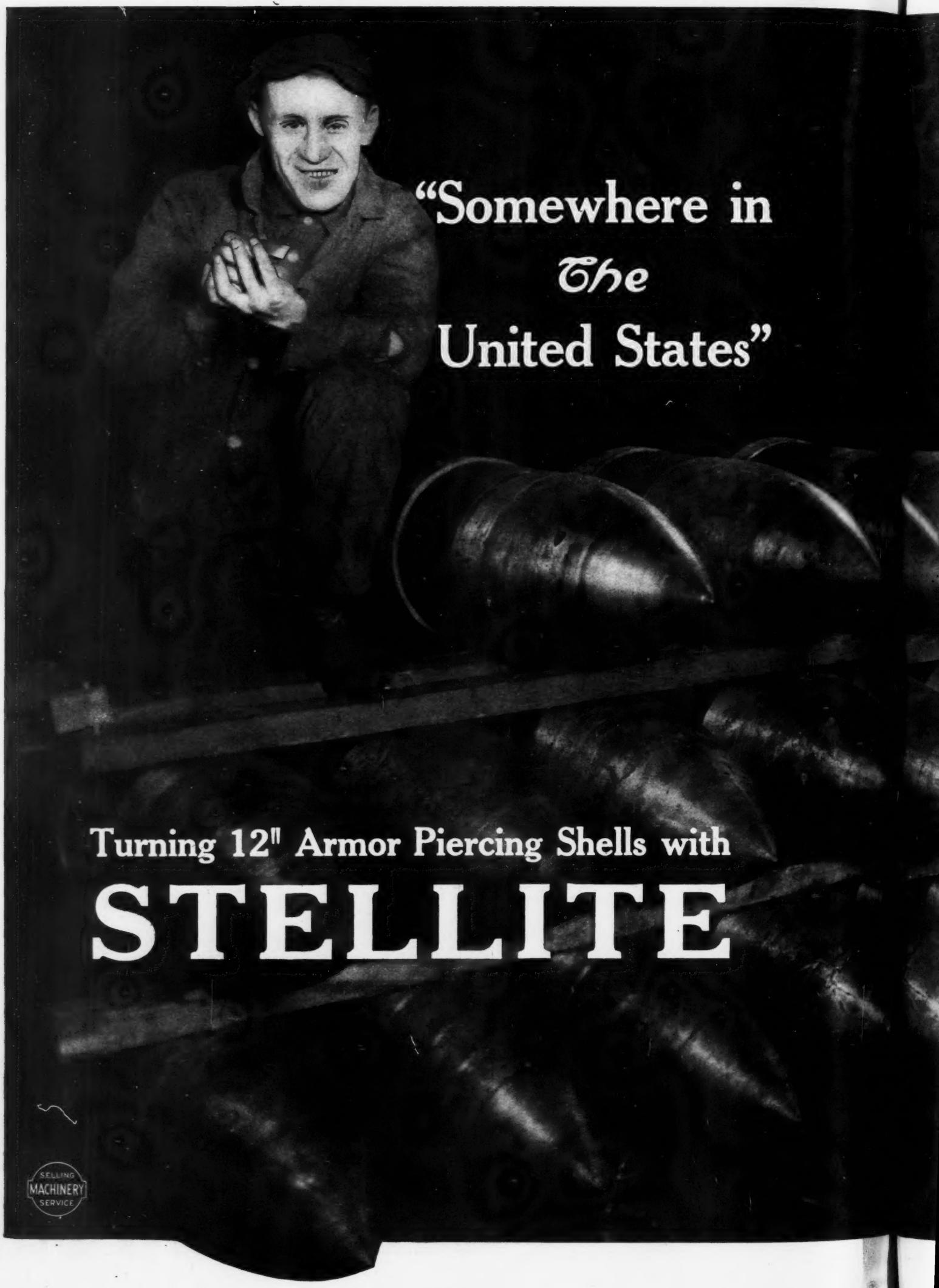
BELOIT WISCONSIN

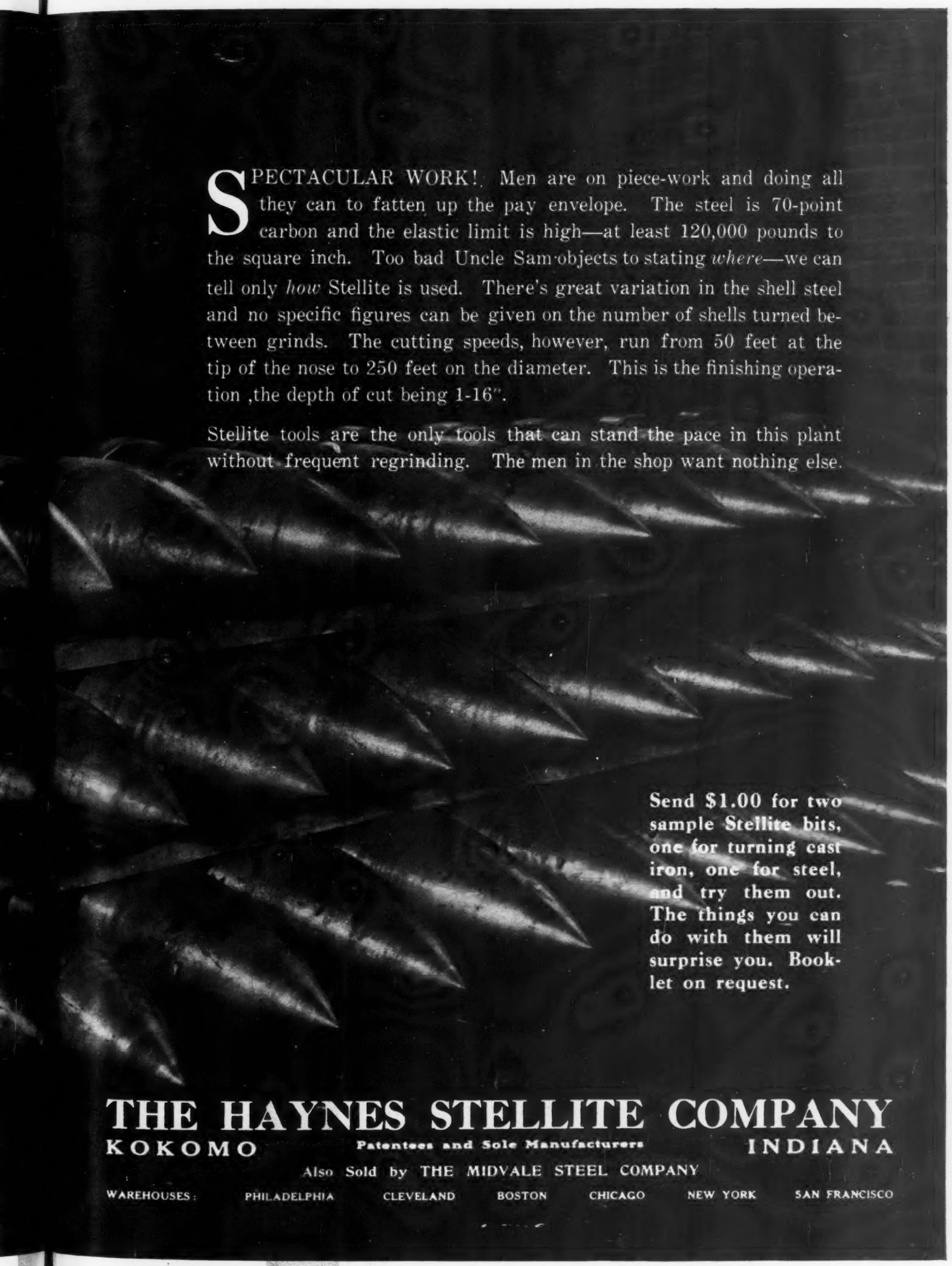
The Largest Manufacturers of Disc Grinders in the World

Illustrating the Possibilities of the

GARDNER GRINDER




"Somewhere in
The
United States"
Turning 12" Armor Piercing Shells with
STELLITE
SELLING
MACHINERY
SERVICE



SPECTACULAR WORK! Men are on piece-work and doing all they can to fatten up the pay envelope. The steel is 70-point carbon and the elastic limit is high—at least 120,000 pounds to the square inch. Too bad Uncle Sam objects to stating *where*—we can tell only *how* Stellite is used. There's great variation in the shell steel and no specific figures can be given on the number of shells turned between grinds. The cutting speeds, however, run from 50 feet at the tip of the nose to 250 feet on the diameter. This is the finishing operation ,the depth of cut being 1-16".

Stellite tools are the only tools that can stand the pace in this plant without frequent regrinding. The men in the shop want nothing else.

Send $1.00 for two sample Stellite bits, one for turning cast iron, one for steel, and try them out. The things you can do with them will surprise you. Booklet on request.

THE HAYNES STELLITE COMPANY

KOKOMO Patentees and Sole Manufacturers INDIANA

Also Sold by THE MIDVALE STEEL COMPANY

WAREHOUSES: PHILADELPHIA CLEVELAND BOSTON CHICAGO NEW YORK SAN FRANCISCO

Lapointe Broaching

Unusual Time on Unusual Work

Broaching rocker shaft bearings at the Ross Gear & Machine Company's plant, Lafayette, Indiana, is the work. Bearings are 6″ long, 1½″ diameter and have six slots, ¼″ radius, running their entire length. The "Lapointe" completes the job, floor to floor, in just three minutes. Output is 20 bearings per hour, or around 200 per day—higher production than can be had from any machine in the shop handling the same work.

The Lapointe Broaching Machine is a machine of many uses. It broaches round, square and irregular holes, cuts keyways, takes care of hard, unusual and the ordinary jobs, and is a speedy worker on every one

Lapointe machines are doing excellent work in manufacturing plants in all parts of the country. They can be made to pay in your shop, too. Ask us to show you.

Write for the Catalogue

The Lapointe Machine Tool Company

Hudson, Massachusetts, U. S. A.

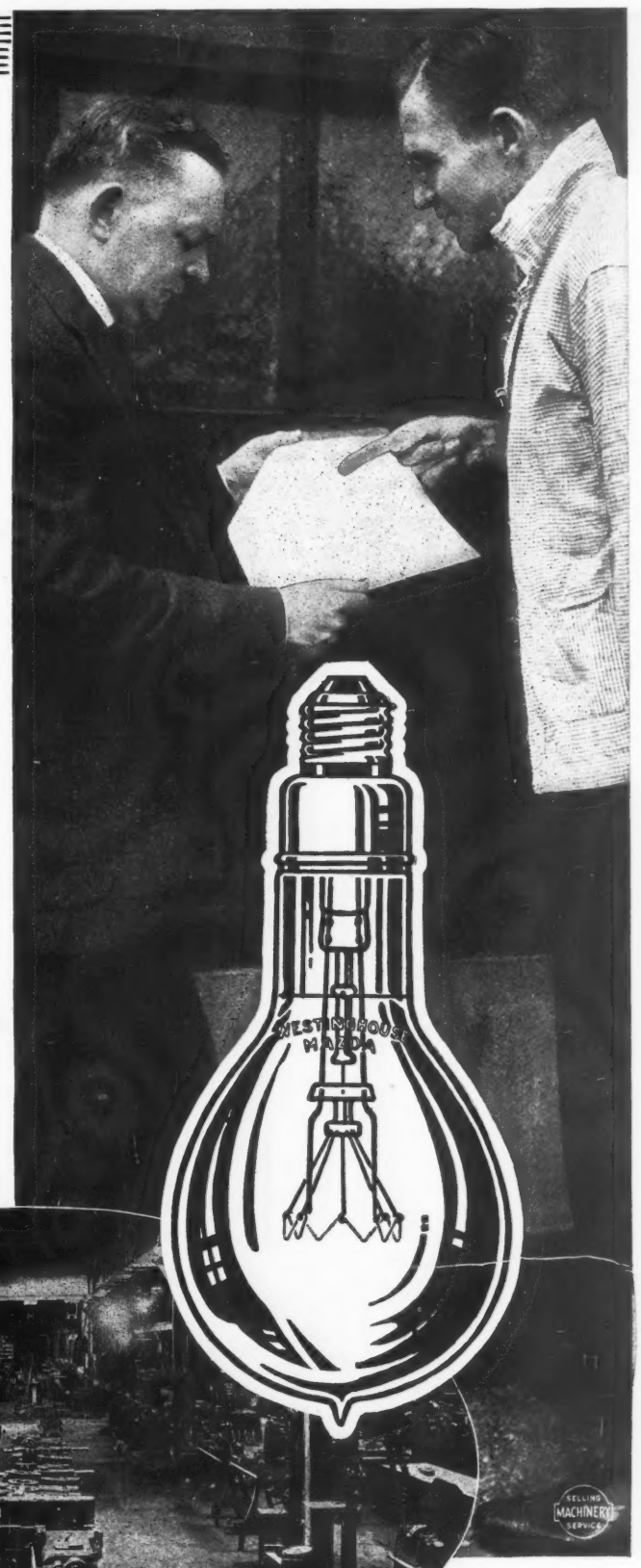
DOMESTIC AGENTS: Motch & Merryweather Machinery Co., Cleveland, Detroit, Cincinnati, Pittsburgh. Prentiss Tool and Supply Co., Buffalo, Syracuse, Rochester, New York and Boston. W. E. Shipley Machinery Co., Philadelphia, Pa. Vonnegut Machinery Co., Indianapolis, Ind. Hill, Clarke & Co., Inc., Chicago, Ill. **FOREIGN AGENTS:** F. G. Kretschmer & Co., Germany. Louis Besse, Paris, France. C. W. Burton, Griffiths & Co., London, England. Wilh. Sonesson & Co., Ltd., Malmo, Sweden. A. H. Schutte, Petrograd. Stokvis & Fils, Brussels. Philip Roeder, Mexico. D. Drury, Johannesburg, South Africa. Alfred Herbert, Ltd., Yokohama. Benson Bros., Sydney, Australia.

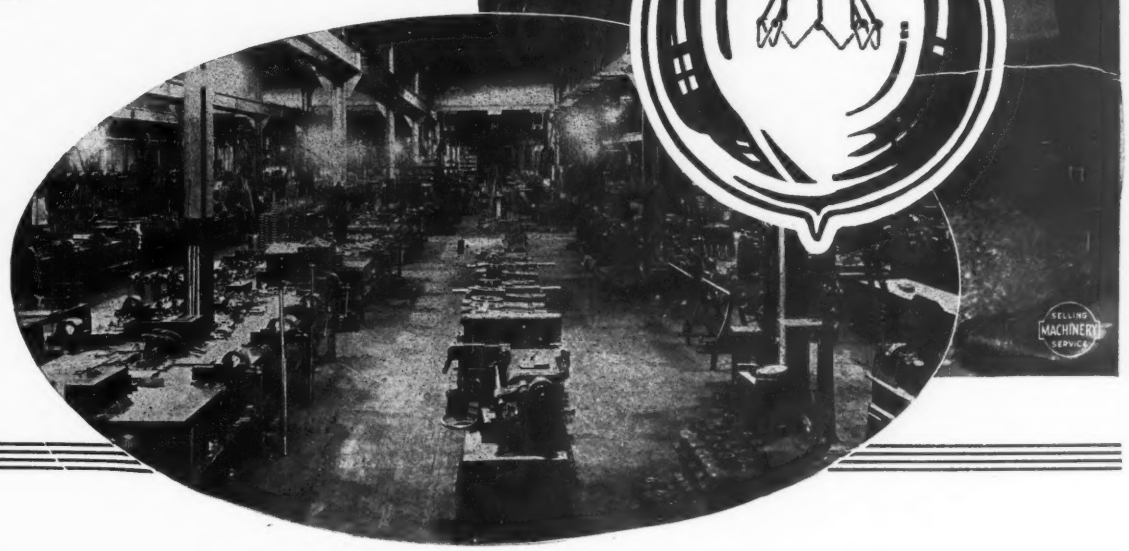
"Give Me Better Light and I'll Give You Better Work"

A poorly lighted shop makes correct reading of blueprints next to impossible; it makes working "to the line" on shaper, planer or milling machine a difficult feat; it makes the reading of fine graduations on scale, machine, etc., an impossibility. **Poor light in a shop is responsible for more errors and more inaccurate work than any other one cause.**

Increased production, savings in spoilage, the decreased number of accidents and the general welfare of the whole shop organization are the results of installing Westinghouse Mazda Lamps in the proper number and arrangement.

We have a field organization of lighting experts—men who are familiar with the needs of shops and factories, and they will gladly consult with you and recommend lighting methods. Start the movement for better light in your shop by writing now for information on the most vital factor in the efficiency of the machine shop—LIGHT.





Light YOUR benches as well as these—it will help you get the best possible workmanship.

Westinghouse Lamp Company

WESTINGHOUSE MAZDA LAMPS

Atlanta, Baltimore, Boston, Buffalo, Butte, Chicago, Cincinnati, Cleveland, Columbus, *Dallas, Denver, Detroit, Kansas City, Los Angeles, Milwaukee, New Orleans, New York, Philadelphia, Pittsburgh, Portland, St. Louis, Salt Lake City, San Francisco, Seattle, Syracuse

*Westinghouse Lamp Corporation

Export Sales Dept., 165 Broadway, N. Y. C

For Canada—Canadian Westinghouse Co., Limited, Hamilton, Ont.

WESTINGHOUSE MAZDA LAMPS

GAUGES

PLUG "

FLAT "

THREAD "

RING "

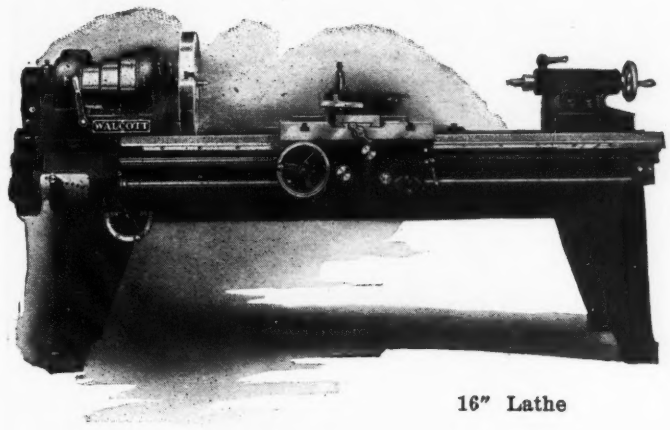
JIGS

Large Output
Prompt Delivery

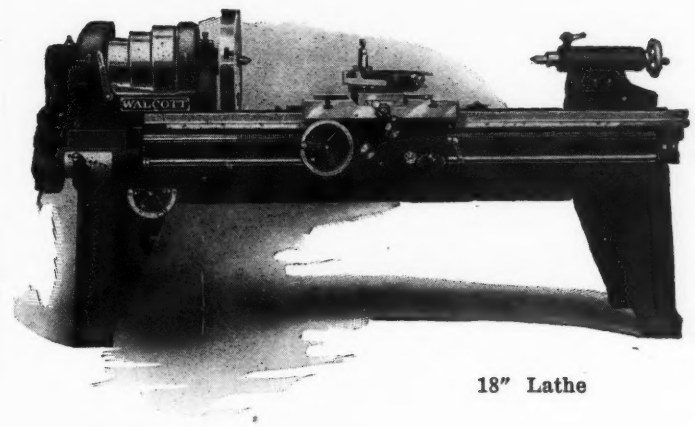
THE CARLSON-WENSTROM CO.

ERIE AVENUE AND RICHMOND STREET

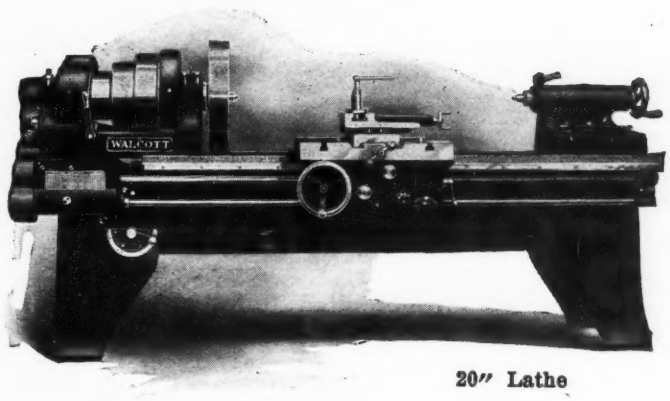
PHILADELPHIA



16″ Lathe



18″ Lathe



20″ Lathe

QUALITY QUANTITY DELIVERY

A first-class tool in factory or tool-room. Made of the best material, on the best of machinery, by the best mechanics. All parts interchangeable.

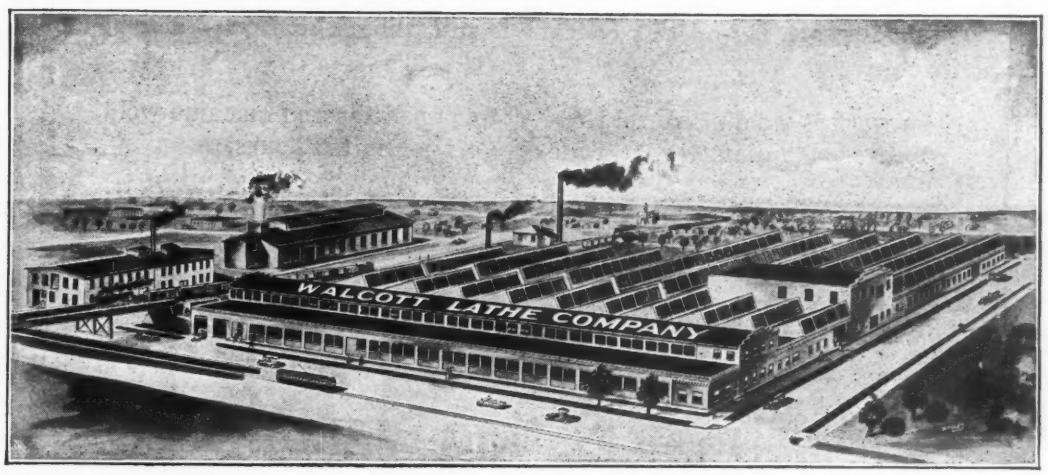
Walcott Lathes

On the Market for 35 Years

Features:—Interchangeability of parts.

Drop forged gears in apron. All steel gears in gear box. Compound rest as rigid as plain rest. Large ways on bed. All gears completely enclosed. Made with 3-step cone, double back gear and quick change gear box only. Rigid inspection. Made in 14″, 18″, 20″, 26″ and 28″ sizes.

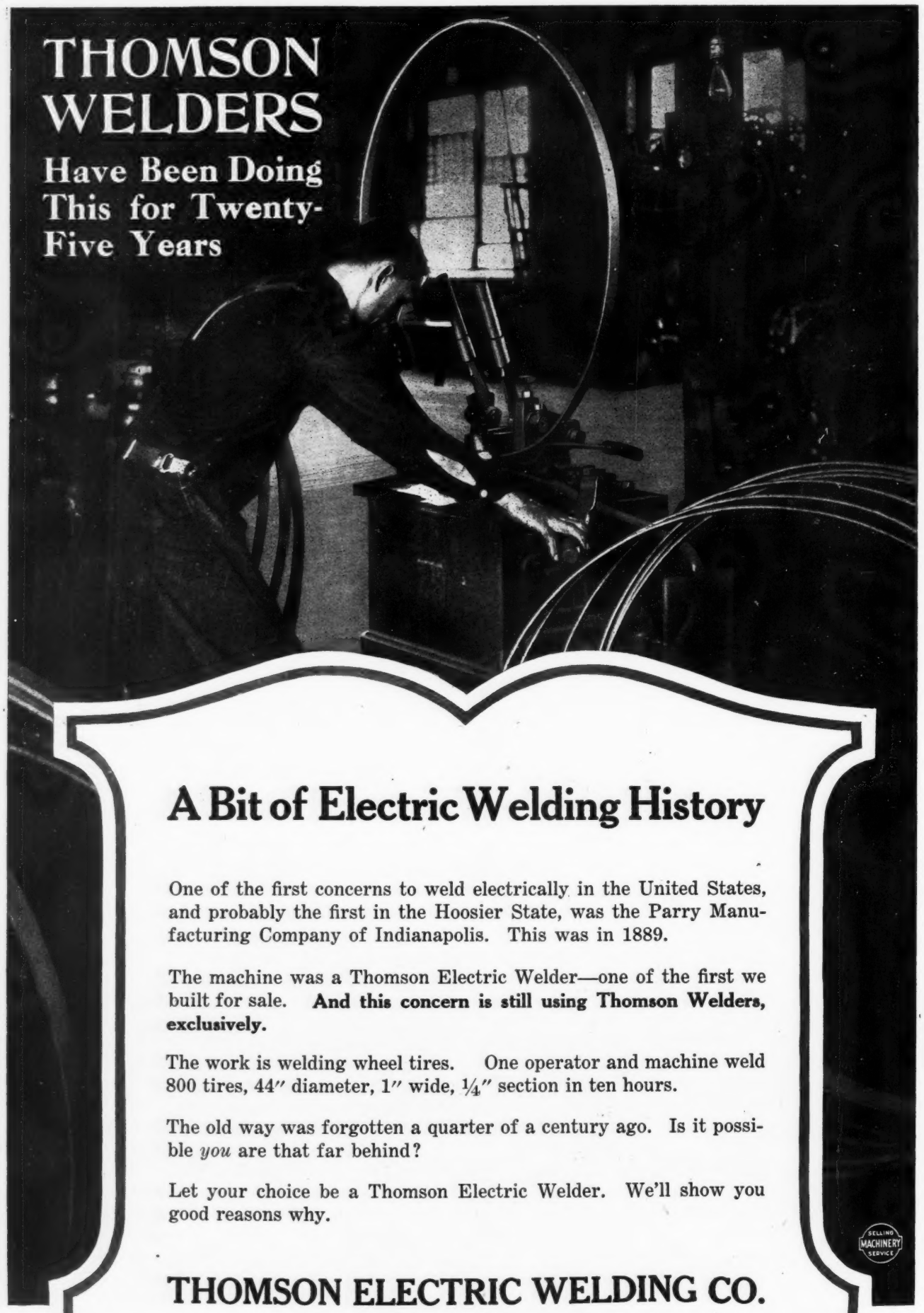
If you want good lathes in quantities and good deliveries, write us.



WALCOTT LATHE COMPANY

Successors to WALCOTT & WOOD MACHINE TOOL CO.

414-420 JACKSON STREET **JACKSON, MICHIGAN**



A Bit of Electric Welding History

One of the first concerns to weld electrically in the United States, and probably the first in the Hoosier State, was the Parry Manufacturing Company of Indianapolis. This was in 1889.

The machine was a Thomson Electric Welder—one of the first we built for sale. **And this concern is still using Thomson Welders, exclusively.**

The work is welding wheel tires. One operator and machine weld 800 tires, 44″ diameter, 1″ wide, ¼″ section in ten hours.

The old way was forgotten a quarter of a century ago. Is it possible *you* are that far behind?

Let your choice be a Thomson Electric Welder. We'll show you good reasons why.

SELLING MACHINERY SERVICE

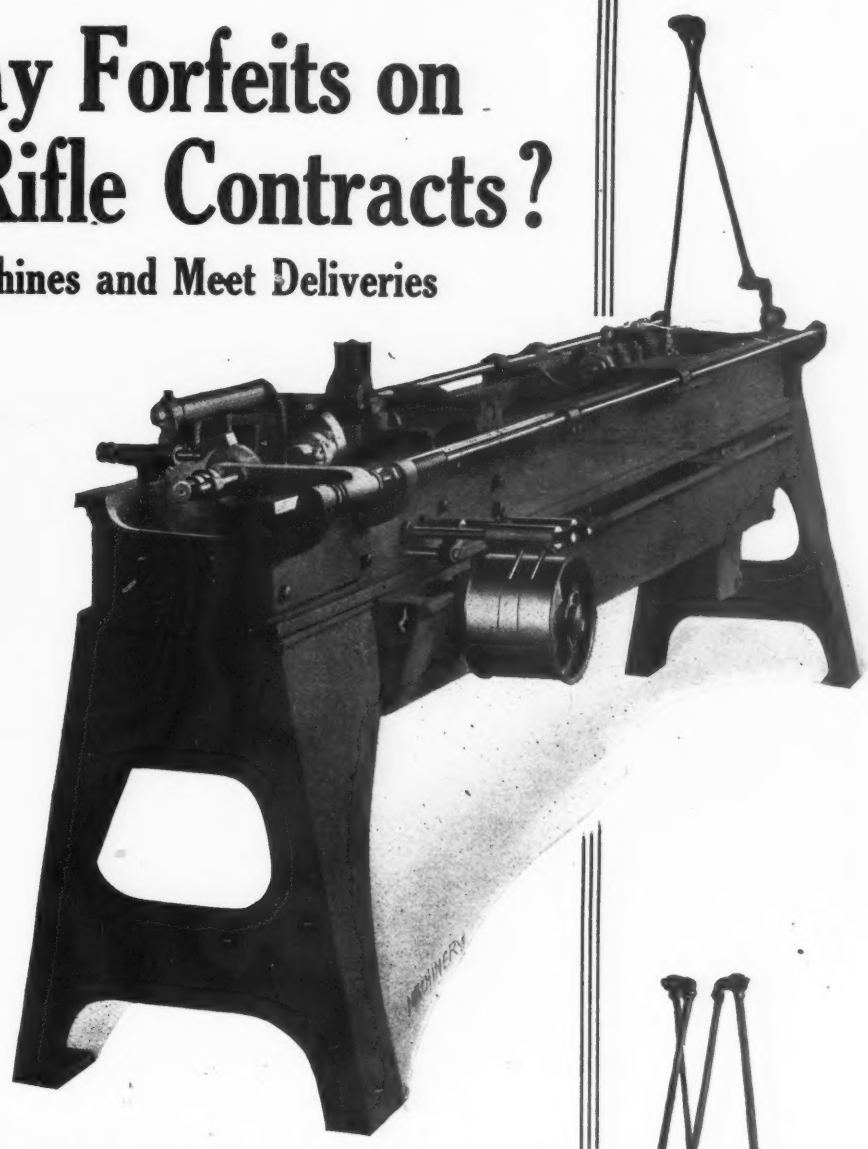
THOMSON ELECTRIC WELDING CO.

LYNN, MASSACHUSETTS, U. S. A.

THE PIONEER MANUFACTURERS

Why Pay Forfeits on Overdue Rifle Contracts?

Use These Machines and Meet Deliveries

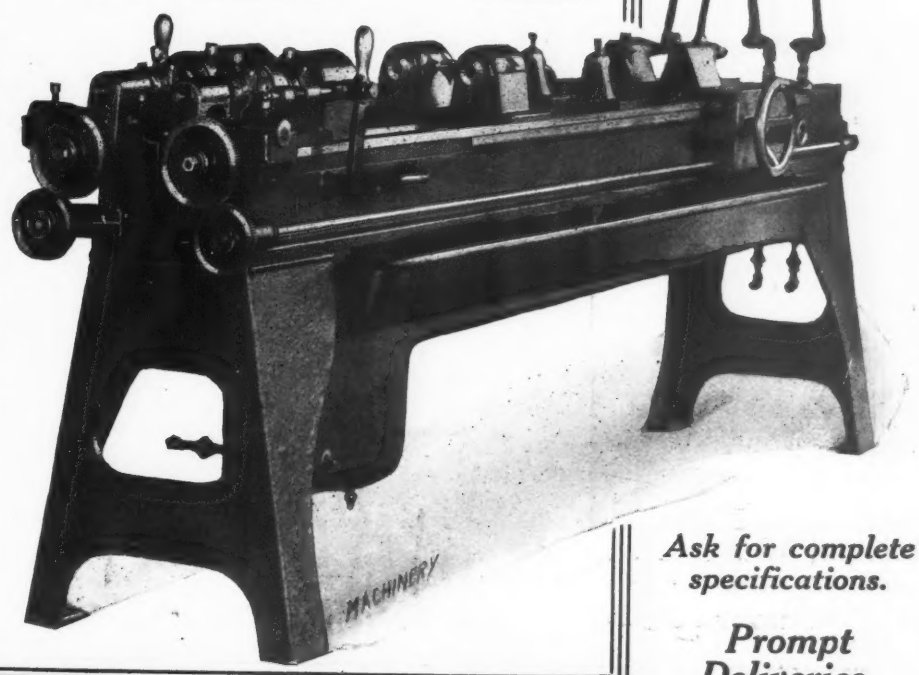


The "Victor" Deep Hole Drilling Machine was developed especially to meet the demand for a tool that would handle deep hole work rapidly and accurately. The drill is stationary and solidly supported. The work revolves and is held rigidly in position by a steadyrest. Special drills having oil holes and grooves at the sides are used. Oil is forced through the drill at a pressure of 500 to 1000 pounds, cooling the work and forcing out the chips. Two spindles work independently and produce very accurate holes.

The "Victor" Rifling Machine combines the same advantages of speed and accuracy in rifling operations. An important feature is the interlocking clamp on the work spindle. By this device a barrel may be removed for examination and returned in exact register with the cutting tool. A barrel can be rifled easily in 10 or 15 minutes. There are big production possibilities in these machines. Let us tell you about them.

The International Engineering Co.

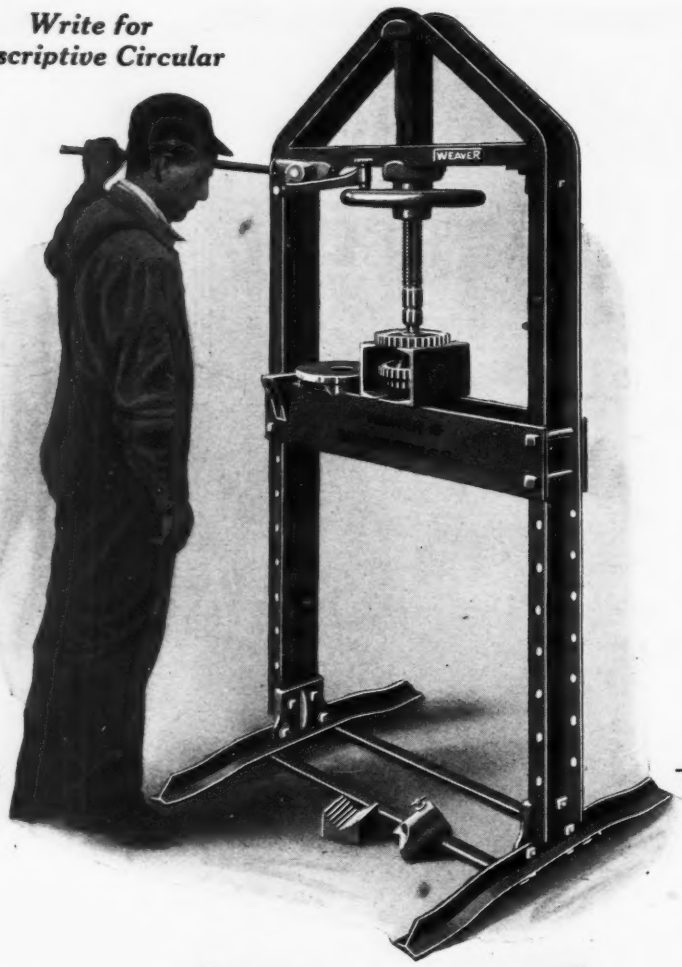
CLEVELAND OHIO



Ask for complete specifications.

Prompt Deliveries.

Write for Descriptive Circular



WEAVER

20-Ton Forcing Press

ROOMY—POWERFUL—QUICK ACTING

THE clean, open, roomy construction of this Press permits it to perform a great variety and range of service.

The solid, ONE-PIECE frame of 5-inch, 9-pound channel steel provides abundant strength with the minimum of bulk and weight.

LEVERAGE 1500 to 1—Our compound leverage principle supplies a leverage of 1500 to 1 at the end of a 30-inch lever. One man can develop a pressure of 20 tons with ease. The perpendicular movement of the lever does not necessitate anchoring the Press. THE SCREW DOES NOT REVOLVE.

GENERAL SPECIFICATIONS—Ball bearing hand wheel, quick-adjusting; bronze thrust bearing; 2-inch mill-cut screw; length of nut on screw, 5 inches; diameter of hand wheel, 15 inches; width of frame, 32 inches; height of frame, 74 inches; weight, crated for shipment, 450 pounds.

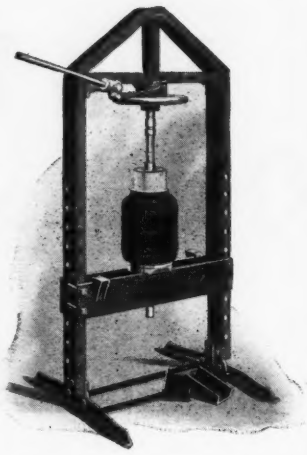
EQUIPMENT—We supply regularly with the Press two sections of 5-inch channel iron blocking, 8 inches long; two extension arms to attach to either end of the bolster, and a vise block equipment for holding awkward pieces against a severe twisting strain.

Net Price, Complete with Equipment **$56.00**

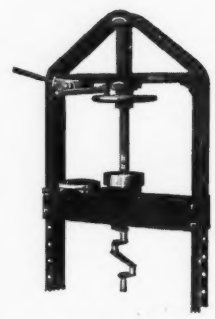
EXTRA WIDE PRESS—We are in position to furnish these Presses in greater width than the regular size specified above at a very nominal additional charge.

Weaver Manufacturing Co.

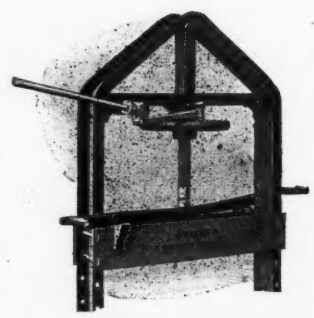
Harvard Park - SPRINGFIELD - Illinois



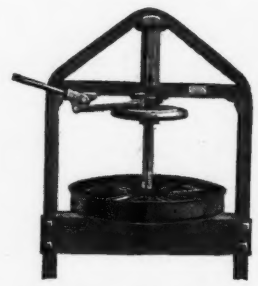
THE GREAT DEPTH ADJUSTMENT will accommodate very large, bulky work.



THERE IS AMPLE ROOM between the bolster plates for all ordinary work.



A VERY WIDE BEARING can be secured for straightening heavy shafts, axles, etc.



THE WIDE FRAME permits large wheels, pulleys, etc., to be handled to advantage.

JOHNSON BRONZE BUSHINGS

have been found from years and years of severe service in all conceivable machines to be

the Bushings

that become the standard for all who once use them

Made in one of the most modernly equipped and operated plants in the country specializing on bushings.

Are your bushings giving you the wear they should?

Are you receiving the Delivery?

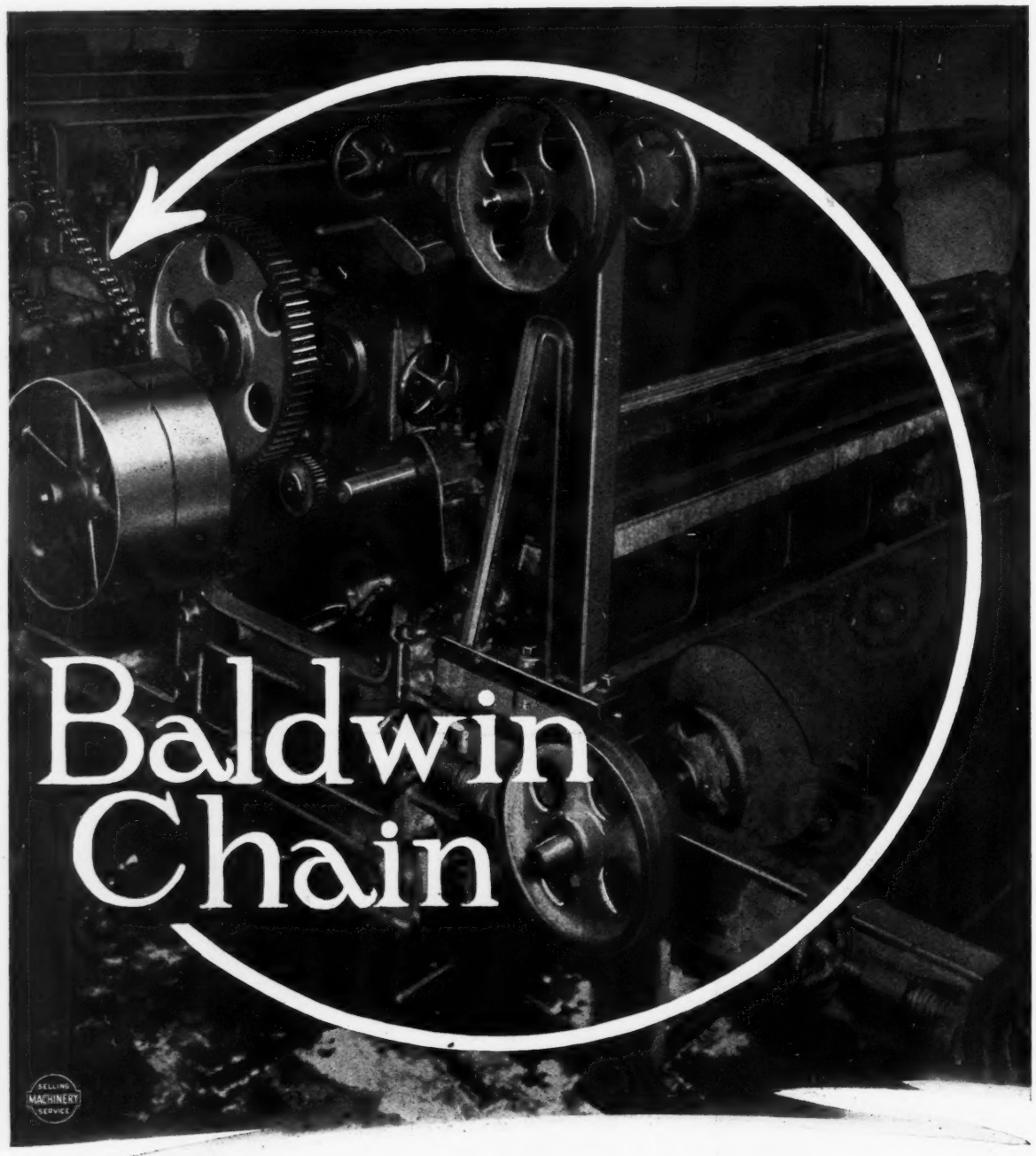
Do you want our Proposition?

Write today—NOW

JOHNSON BRONZE COMPANY

FORMERLY THE AMERICAN CAR & SHIP HARDWARE MFG CO.

NEW CASTLE, PA.



Another Special Machine

On Which Part of the Drive is Baldwin Chain

This is a paper corrugating machine, designed by the Potdevin Machine Company, Brooklyn, N. Y., and the drive to the upper rolls is a Baldwin Special Roller Chain, the center distance between sprockets being approximately two feet. The advantage of chain over gears or belts for many purposes has been demonstrated by the above concern to its complete satisfaction—and the chain selected is "Baldwin."

Baldwin Chain is good chain. It has many uses and many advantages. May we tell you more about it? Address Department "S".

Baldwin Chain & Mfg. Co., Worcester, Mass., U. S. A.

AGENTS: C. D. Schmidt, 276 Canal St., New York City. W. D. Foreman, 1425 Michigan Ave., Chicago, Ill. N. A. Petry Co., Inc., 1309 Race St., Philadelphia, Pa. Walter H. Williams, 175 Massachusetts Ave., Boston, Mass. M. A. Bryte, 788 Mission St., San Francisco, Cal. Motor & Machinists Supply Co., Kansas City, Mo. M. & M. Co., Cleveland, Ohio. Neustadt Automobile & Supply Co., St. Louis, Mo. C. J. Smith Co., St. Paul, Minn.

"I'll Remember that Name 'SPARTAN'

"The trade mark says 'Spartan.' I suppose it was named after those old Spartans—the fellows who could stand 'most everything.

"This belt was on the machine when I started in here three years ago and it has certainly stood some hard service. Doesn't slip, stretch or glaze. Guess the boss knew what he was doing when he picked this belt—why, it's good for years yet. I'll keep that G & K Spartan trade mark in mind—I may be able to use the information some day."

The operator is pretty close to the belt. He appreciates a good one because he is often the loser from a poor one. Any Graton & Knight belt makes good because it is made from selected hides tanned by superior processes. Heat, cold, strain, water, oil, or acid fumes have no ill effect on "Spartan" Belting." It's the belting supreme.

A New G&K catalog is just off the press. Lists our complete and extensive line—belts for all purposes. A postal brings a copy.

THE GRATON & KNIGHT MFG. CO.
WORCESTER Branches in Principal Cities MASS., U.S.A.
OAK LEATHER TANNERS AND BELT MAKERS

INTRODUCING

"It Shears"

While this is the first public announcement of "The Shear Cutting Tap," it must be clearly understood that the "Gun" Tap has long passed the experimental stage—has been tested and approved by many of the best known users of taps in the country.

Greenfield "Gun" Taps must not be confused with the various two- and three-fluted taps now on the market. The principles of construction are patented and the patents owned by the Greenfield Tap and Die Corporation.

Consider carefully the essential points of advantage of the "Gun" tap over the "common or garden variety."

Why it is Called "The Shear Cutting Tap"

The cutting edges at the point are ground at an angle to the axis (see illustration, F). This enables the tap to cut with a shearing action and the angle deflects the chips so that they curl out and *ahead* of the tap and do not break up and collect in the flutes.

Ease of Cutting

Note the hook on the cutting edge (G). This combined with the shear-cutting action makes the "Gun" Tap the easiest cutting tap on the market.

On especially tough jobs—through layers of material of varying hardness it cuts hole after hole with perfect ease.

Strength

The flutes of the "Gun" Tap are less in number and shallower than those of the ordinary tap—therefore, in itself is almost as strong as solid stock. Couple with this its easy-cutting qualities and you have a tap that practically never breaks.

This is *some* statement, when you take into consideration the generally accepted belief that 90 per cent of all taps break.

Accuracy

All the cutting is done by the first few teeth—the rest of the thread acts as a lead screw steadying the tap and producing a very accurate thread.

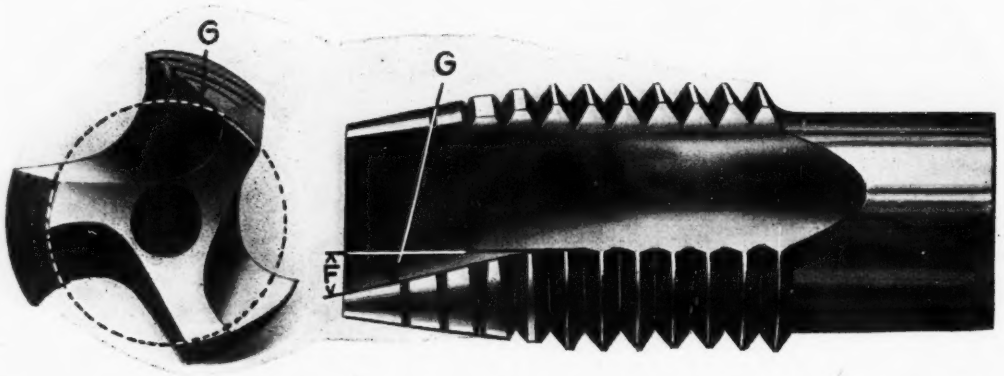
The "Gun" Tap will cut closer to size in all materials than any other tap made. It will also maintain its cutting size until it is ground down to the last two or three threads.

Production

Because of its easy cutting qualities—less power to drive—the "Gun" Tap is capable of greatly increased cutting speeds. Furthermore there is no lost time due to removing broken taps or frequently backing out the tap from deep holes to clean collected chips from the flutes.

There will be a tremendous saving in your tapping costs if you let the "Gun" Tap do your work.

Send to-day for the illustrated bulletin which goes into details regarding this remarkable Tap.



GREENFIELD TAP & DIE COR-

WELLS BROTHERS CO. Division — WILEY & RUSSELL

NEW YORK, 28 Warren St. — CHICAGO, 13 So. Clinton St. — PHILADELPHIA, 38 No. Sixth St.

The "GUN" TAP

Greenfield Taps

The Gun Tap is the Tool For Work Like This

A few months ago the Ready Tool Company, Bridgeport, Conn., tried out, for the first time, Greenfield Gun Taps for tapping binding screw holes in tool holders. There is now no intention of using anything else. This work is particularly tough; the holders are made from chrome nickel steel; the requirements very strict as to accuracy and finish. In the work shown the tap is ½"-13 and the depth of the tapped section ⅞".

This, of course, is machine tapping; but Gun Taps are used by the Ready Company for hand tapping also, and have demonstrated their superiority for work of this character. Gun Taps work freer and stand more abuse than other taps. We can cite other instances where manufacturers have been stumped on tough jobs on which ordinary taps refused to work—the "Gun" Tap has solved the problem. We recommend Gun Taps for tough work. Try them.

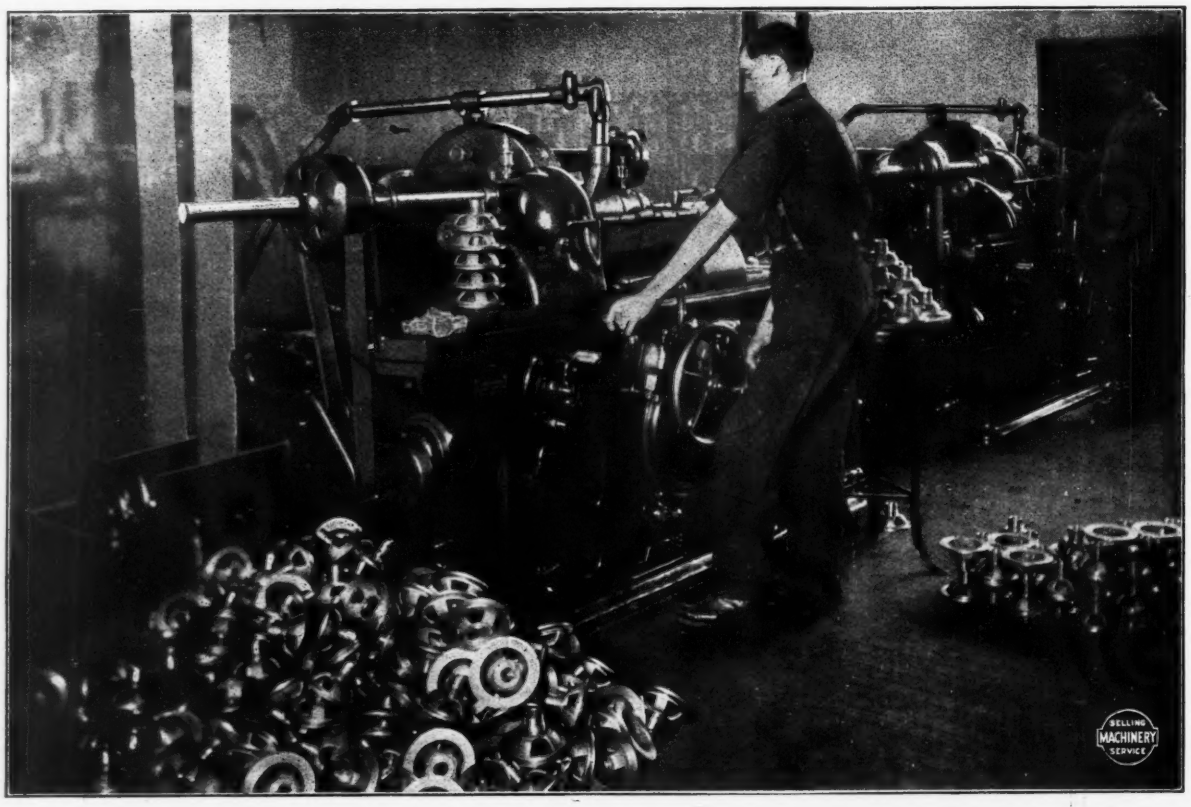
PORATION, Greenfield, Mass., U. S. A.

MFG. CO. Division — A. J. SMART MFG. CO. Division

DETROIT, 55, 57, 59 Wayne St.

LONDON, 149 Queen Victoria St.

CANADA, Wells Bros. Co. of Canada, Ltd., Galt, Ont.



Two Recently Installed LANDIS GRINDERS

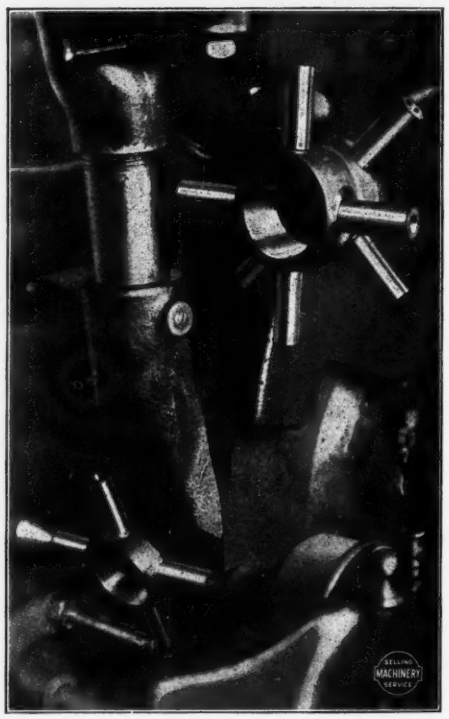
and Some of the Work They Handle

This pair of Landis Grinding Machines has been installed six months—and you can judge for yourself what they are doing and how well they are doing it by the work they happened to be on when the photographs were snapped.

The machine in the foreground is grinding hubs, 3-16″ wide by 1.5745″ diameter, on malleable iron differential parts; the limits being nothing over and only 0.0005″ under size. The second machine is grinding differential gear crosses, four ground sections, 5/8″ diameter by 1 5/8″ long, within limits of 0.001″.

This work is produced in big quantities, by one of the foremost manufacturers of automobile parts of this character, and you can rest assured that the Landis is the most economical Grinding Machine for the purpose or these two never would have been installed.

Let us send the Bulletin and more details on this new Landis Self-Contained Grinding Machine—the grinder in which all overhead works are done away with, in which gearless drive, centralized control and many other features contribute to speed and efficiency.



LANDIS

LANDIS TOOL COMPANY, Main Office and Works: **WAYNESBORO, PA.**

NEW YORK OFFICE: 50 CHURCH STREET

AGENTS: Dewstoe Machine Co., Birmingham, Ala. Harron, Rickard & McCone, San Francisco and Los Angeles.

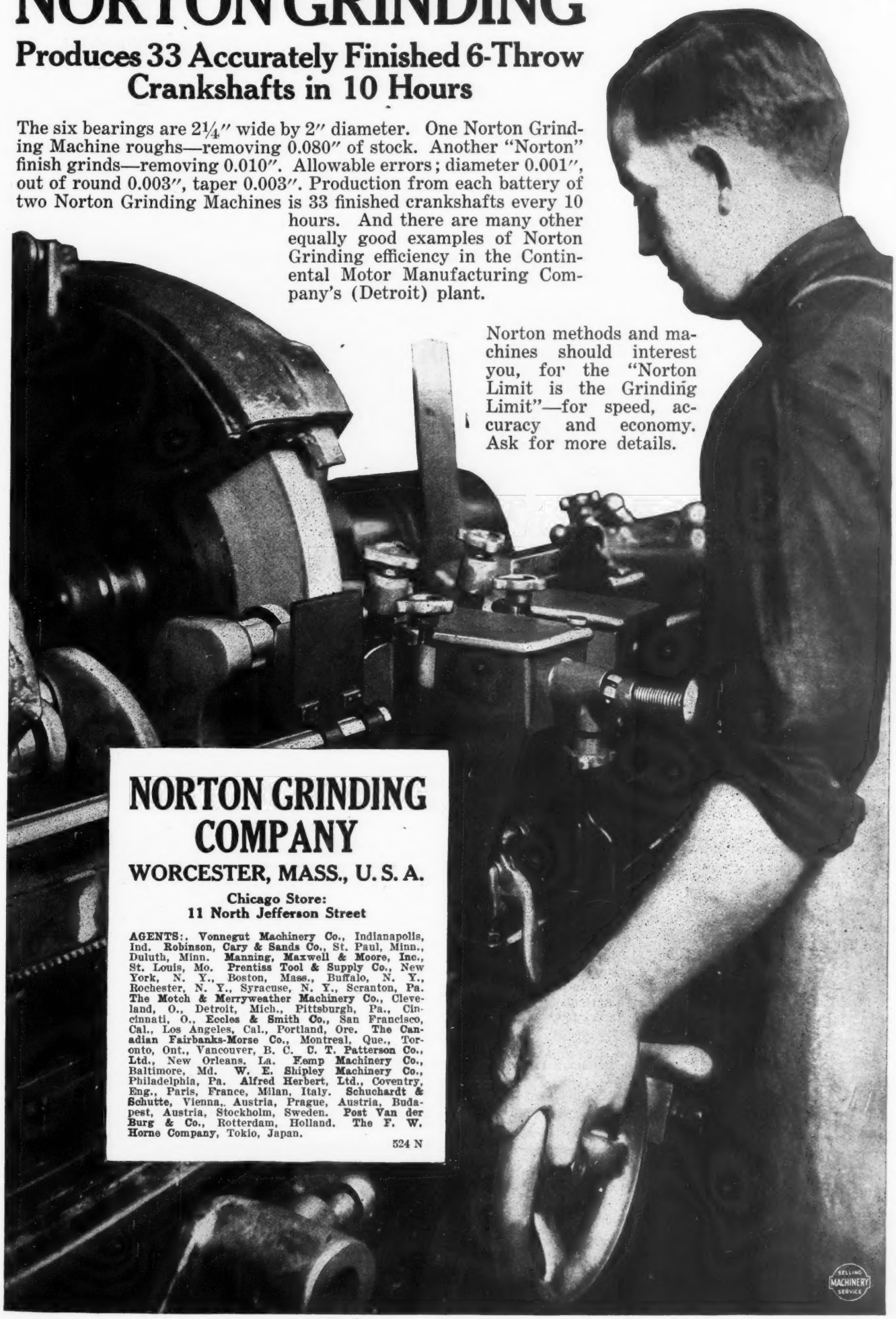
UNIVERSAL GRINDING MACHINES
INTERNAL GRINDING MACHINES
PLAIN GRINDING MACHINES
CRANK GRINDING MACHINES
ROLL GRINDING MACHINES
CAM GRINDING MACHINES

NORTON GRINDING

Produces 33 Accurately Finished 6-Throw Crankshafts in 10 Hours

The six bearings are 2¼″ wide by 2″ diameter. One Norton Grinding Machine roughs—removing 0.080″ of stock. Another "Norton" finish grinds—removing 0.010″. Allowable errors; diameter 0.001″, out of round 0.003″, taper 0.003″. Production from each battery of two Norton Grinding Machines is 33 finished crankshafts every 10 hours. And there are many other equally good examples of Norton Grinding efficiency in the Continental Motor Manufacturing Company's (Detroit) plant.

Norton methods and machines should interest you, for the "Norton Limit is the Grinding Limit"—for speed, accuracy and economy. Ask for more details.



NORTON GRINDING COMPANY

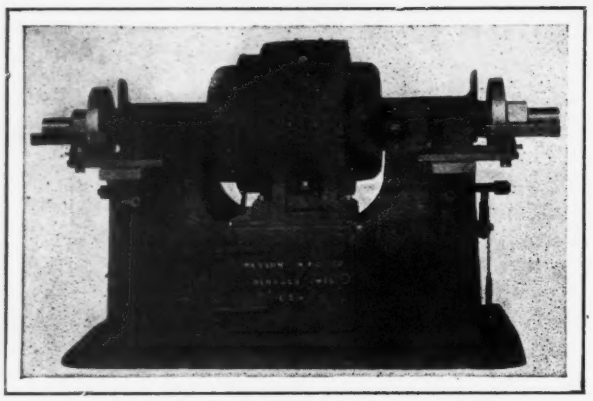
WORCESTER, MASS., U. S. A.

Chicago Store:
11 North Jefferson Street

AGENTS: Vonnegut Machinery Co., Indianapolis, Ind. Robinson, Cary & Sands Co., St. Paul, Minn., Duluth, Minn. Manning, Maxwell & Moore, Inc., St. Louis, Mo. Prentiss Tool & Supply Co., New York, N. Y., Boston, Mass., Buffalo, N. Y., Rochester, N. Y., Syracuse, N. Y., Scranton, Pa. The Motch & Merryweather Machinery Co., Cleveland, O., Detroit, Mich., Pittsburgh, Pa., Cincinnati, O., Eccles & Smith Co., San Francisco, Cal., Los Angeles, Cal., Portland, Ore. The Canadian Fairbanks-Morse Co., Montreal, Que., Toronto, Ont., Vancouver, B. C. C. T. Patterson Co., Ltd., New Orleans, La. Femp Machinery Co., Baltimore, Md. W. E. Shipley Machinery Co., Philadelphia, Pa. Alfred Herbert, Ltd., Coventry, Eng., Paris, France, Milan, Italy. Schuchardt & Schutte, Vienna, Austria, Prague, Austria, Budapest, Austria, Stockholm, Sweden. Post Van der Burg & Co., Rotterdam, Holland. The F. W. Horne Company, Tokio, Japan.

524 N

Ransom Motor Driven Grinding Machines



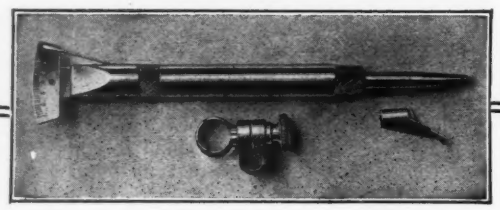
Cut shows our No. 48 Grinding Machine

Bearings 15 x 3¼", ring oiling.
Motor Direct Current 15 H. P.—900 R. P. M.
Furnished with automatic starter with push button control.
Ransom Patent Speed Controller.
Weight complete, 4000 lbs.

Good Deliveries

A Full Line of Grinding Machinery

Ransom Manufacturing Company, Oshkosh, Wis.

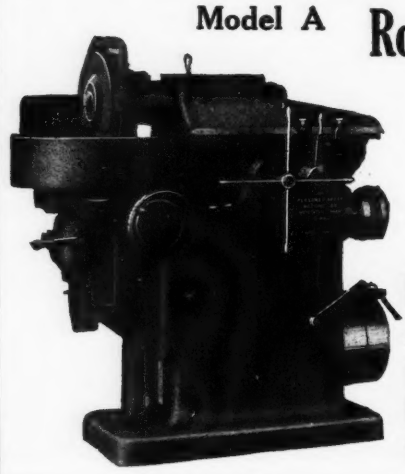


"Be Sure You Are Right—Then Go Ahead"

The ROBINSON TEST INDICATOR readily clamps to the binding post of a standard surface gauge and indicates the slightest variations. Metric and English readings. Many uses. Try one to make sure all parts of your machines bear true relation to each other. Price is low. Send for details. For Sale at your Tool Dealers—Ask to see them.

C. E. ROBINSON COMPANY
96 W. RIVER STREET ORANGE, MASS.

Model A



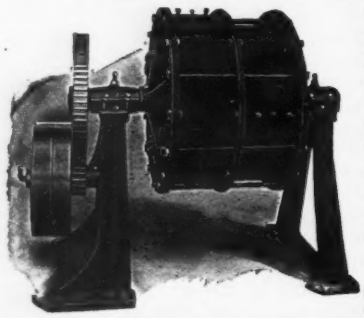
Rotary Surface Grinders

8" and 12" equipped with

P-A Magnetic Chuck

The Persons-Arter Machine Company
Worcester, Mass., U. S. A.

A High Polish at Low Cost



The Abbott Tumbling Barrel Process puts a high polish on hundreds of small metal pieces at one operation without injuring the work; does it accurately and uniformly, and is particularly economical. One man can attend as many as 4 or 5 machines.

Samples burnished free and estimates furnished on request.

THE ABBOTT BALL COMPANY
ELMWOOD, HARTFORD, CONN.

A Complete Indicator for $2.50

There is no indicator on the market at less than four times the cost of the "Ideal" that can do the same work without extra attachments. It can be used in every conceivable position in places hard to reach. Accurate and extremely sensitive; bearings bronze bushed to prevent sticking. Very compact—weight ¾ ounce.

Immediate Shipments

JOHNSON & MILLER
42 Murray St., New York
Your Dealer or Direct

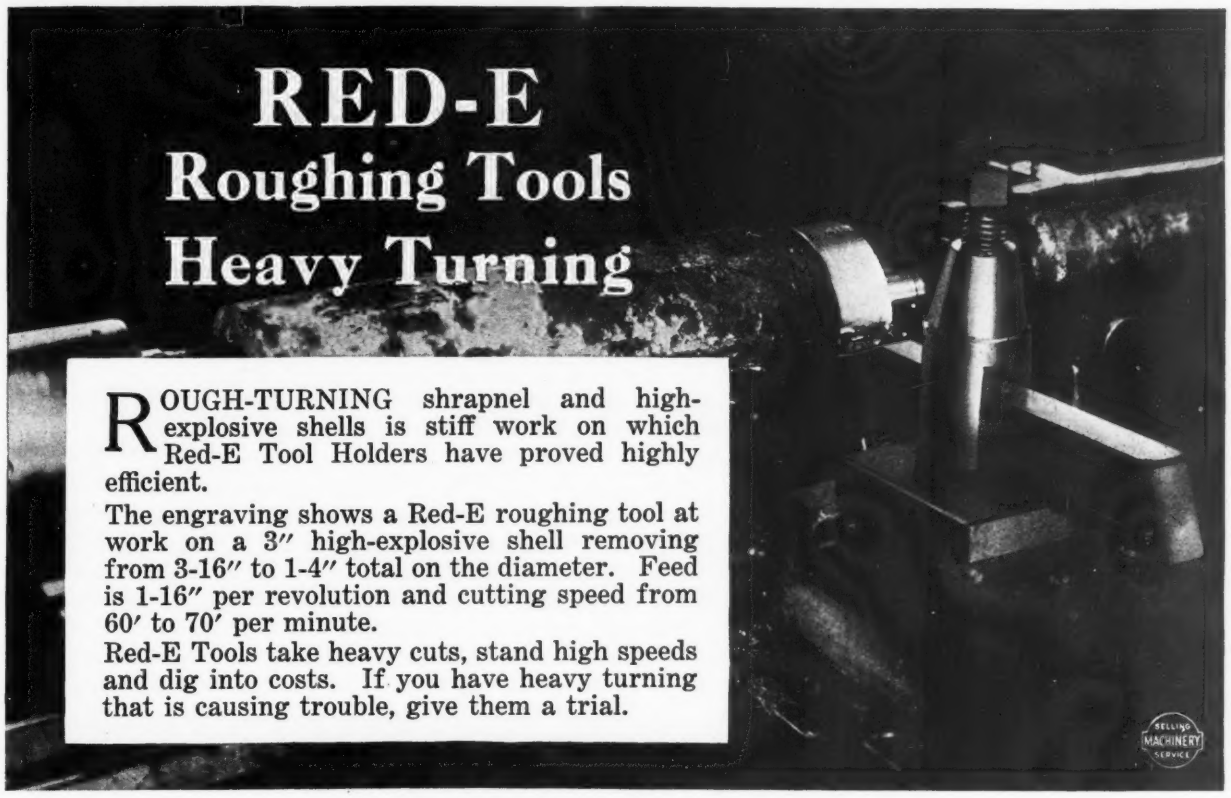
30 Days' Free Trial

Reamers,
Measuring Standards,
Adjustable Hollow Mills,
Mandrels, Etc.

ROGERS TOOLS

1865 1915

THE JOHN M. ROGERS WORKS, INC.
Gloucester City, N. J., U. S. A.
Catalogue 8.



ROUGH-TURNING shrapnel and high-explosive shells is stiff work on which Red-E Tool Holders have proved highly efficient.

The engraving shows a Red-E roughing tool at work on a 3″ high-explosive shell removing from 3-16″ to 1-4″ total on the diameter. Feed is 1-16″ per revolution and cutting speed from 60′ to 70′ per minute.

Red-E Tools take heavy cuts, stand high speeds and dig into costs. If you have heavy turning that is causing trouble, give them a trial.

Complete line listed in catalogue—write for your copy

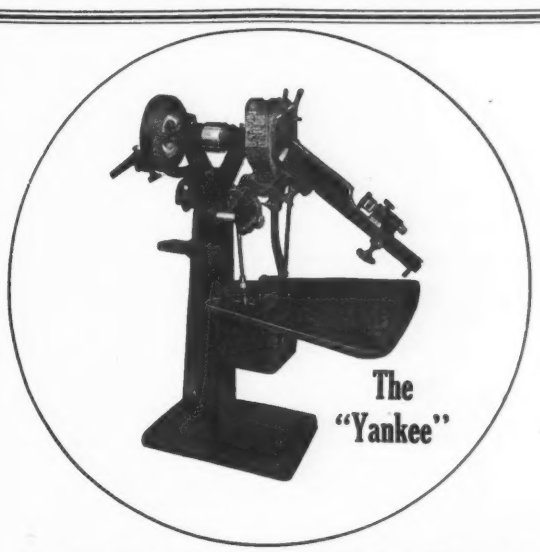
THE READY TOOL COMPANY
BRIDGEPORT CONN., U. S. A.

Detroit Grinding Wheels

Are made from natural or artificial abrasives and in grades to meet all grinding requirements. They wear well and are as lasting as modern methods can make them. Since Detroit quality never varies, duplicates, accurate to a hair, can be had at all times.

More particulars on request

DETROIT GRINDING WHEEL COMPANY
DETROIT, MICH.



Your men do not like to grind drills on a machine with complicated adjustments —they'd rather grind by hand. Hand grinding results in inaccurate tools, oversize holes and loss through breakage. Put a "Yankee" Drill Grinder in your tool-room — your men will *use* the "Yankee" because it is simple, requires only two adjustments to finish from *three to four drills a minute*, and the quality of its work is absolutely beyond question.

Circular tells more—ask for it.

Wilmarth & Morman Co.
1180 Monroe Ave., N.W. GRAND RAPIDS, MICH.

$60.00 Buys This Waterbury Grinder

And a very brief trial will be enough to prove how good the investment is. Simple design and extra strong construction combine to insure rapid and accurate operation and the greatest durability.

FULLY GUARANTEED

THE BLAKE & JOHNSON CO.
WATERBURY CONN.

There's Nothing Much Harder on a Grinding Wheel Than Rough Steel Castings

If you have ever tried grinding of this kind you know what the sand and scale do to a wheel. It is just about as tough a proposition as ever was.

One of our large customers knows, for a great deal of work of this character goes through their plant—and grinding wheels were a source of more or less trouble (generally more) until Abrasive Wheels were adopted.

The cast steel pinion shown, for a sugar refining machine, is typical of the work. The teeth are cast, then ground. It is rough, tough grinding, and an Abrasive Wheel, 10″ by 1″ at 1400 R. P. M., *outlasts anything this customer ever used before.*

An

ABRASIVE WHEEL

Does the Trick

Try Abrasive Wheels—for any grinding purpose. You'll find them good wheels—always.

ABRASIVE COMPANY

Formerly The Abrasive Material Co.

Main Office and Works: Bridesburg, Philadelphia

Chicago Branch: 566 West Randolph Street, Chicago, Illinois

SELLING MACHINERY SERVICE

BESLY FORGED NUT TAPS

(PATENTED)

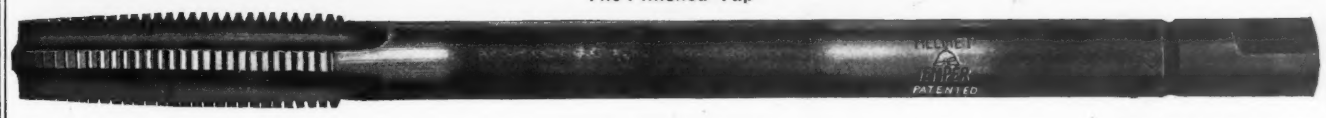
Unequaled for ACCURACY and LONG LIFE

Flutes are Forged—Not milled · Forging Refines, Compacts and Improves the steel

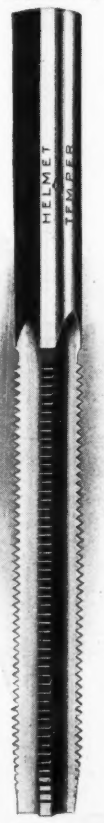
The Shank Size, Unannealed Blank

The Forging

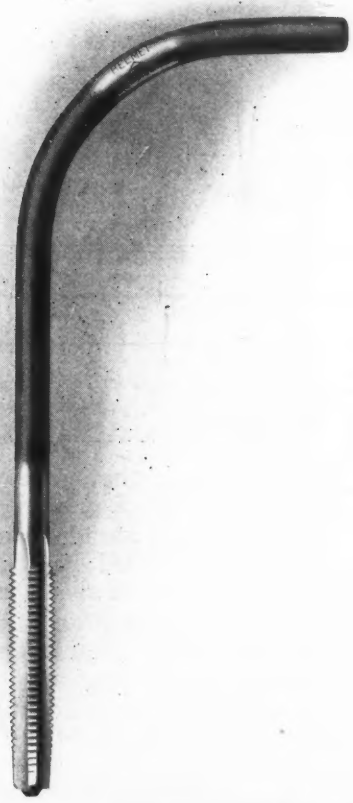
The Finished Tap



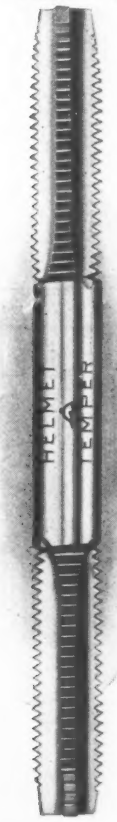
Single End Automatic Tapper Tap

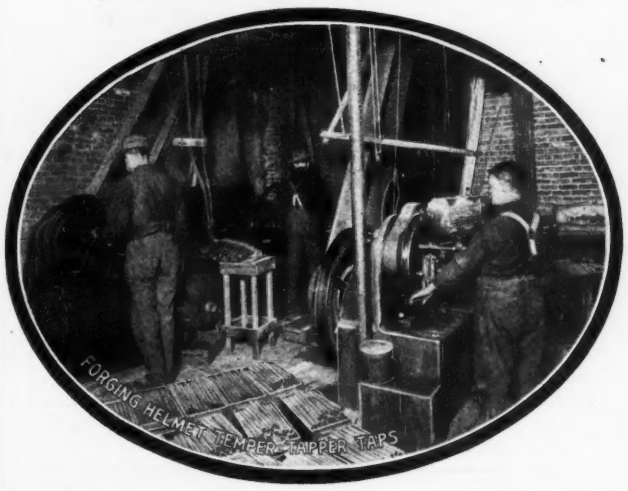


Bent Shank Automatic Tapper Tap



Double End Automatic Tapper Tap





BESLY FORGED NUT TAPS have won their way on sheer ability to tap nuts at the minimum tap cost; and today are used exclusively by more large nut manufacturers than all other makes of nut taps combined. A trial will convince you.

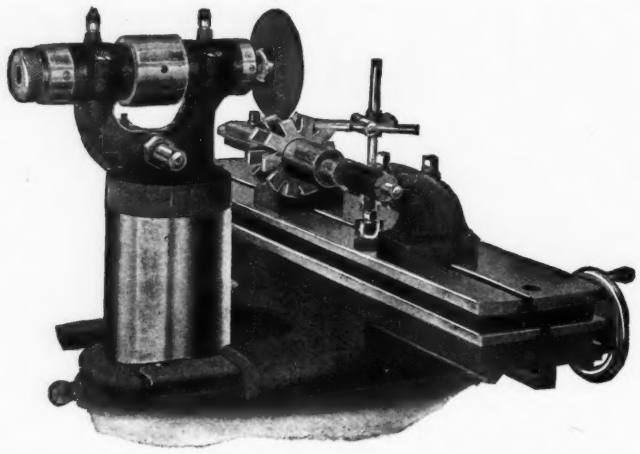
Besly Hand, Pipe and Boiler Taps are just as good as Besly Nut Taps. Give them a trial and be convinced.

Ask for 1916 Besly Tap Catalogue

CHARLES H. BESLY & COMPANY

120 B North Clinton Street CHICAGO

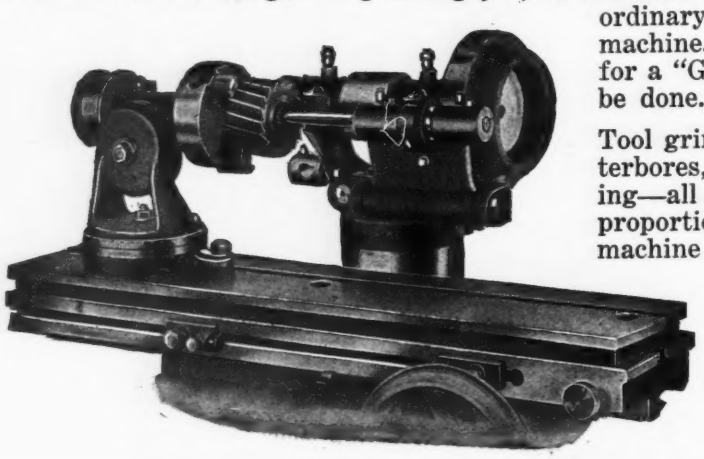
For Tool Room or Shop—a Good All 'Round Grinder



The Greenfield

Universal Grinder

There is hardly a shop where this versatile machine will not fit in and turn out good work economically. It is difficult to imagine a grinding job, such as the ordinary shop would have, that could not be handled on this machine. We show two commonplace jobs that are easy for a "Greenfield"; they give but a suggestion of what can be done.

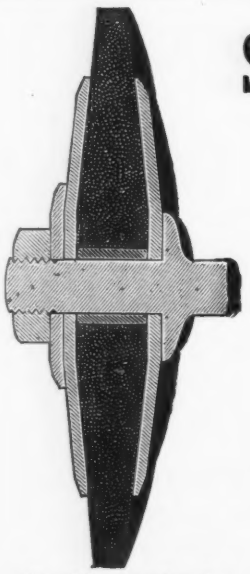


Tool grinding of every kind—cutters, reamers, taps, counterbores, gages, etc.; surface, cylindrical and internal grinding—all can be done quickly and accurately. A heavy well proportioned knee supporting stiff, ribbed slides gives the machine unusual rigidity for its size.

If you need a tool room grinder, don't fail to investigate this.

Greenfield Machine Company

Greenfield, Mass., U. S. A.



Send for catalog for complete information.

The Safety Emery Wheel Company

SPRINGFIELD, OHIO

FOREIGN REPRESENTATIVES: Farmer & Co., London. Adler & Eisenschitz, Milan. Allied Machinery Co. of America, Paris.

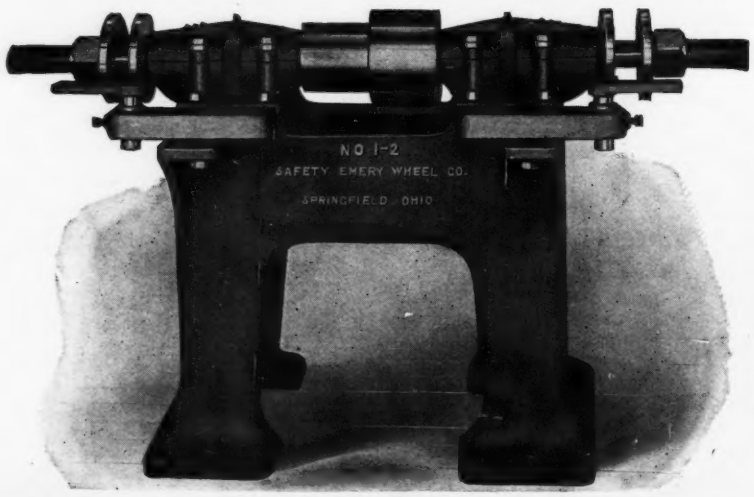
Safety Wheels, Safety Collars, Safety Machines

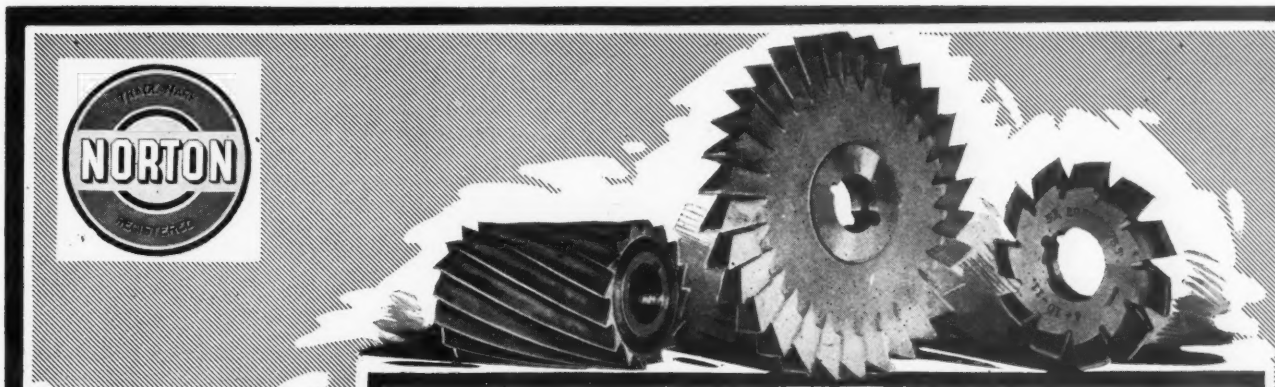
A combination that permits high speed production with safety both to your work and to your workmen.

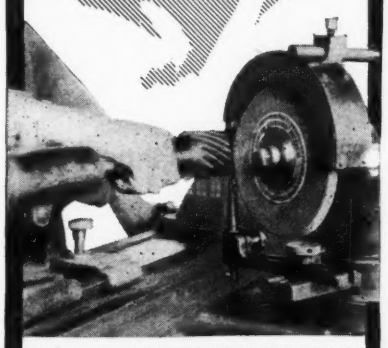
Safety Wheels stand tests of speeds 50 per cent higher than would be required in regular practice, and if equipped with Safety Collars are absolutely safe.

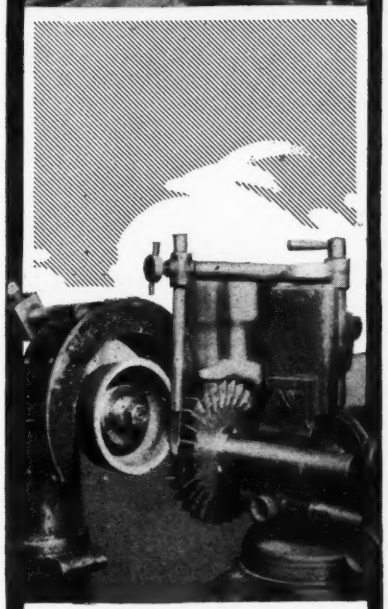
Safety Grinding Machines possess that balance, rigidity and strength which permit operation of Safety Emery Wheels at maximum capacity.

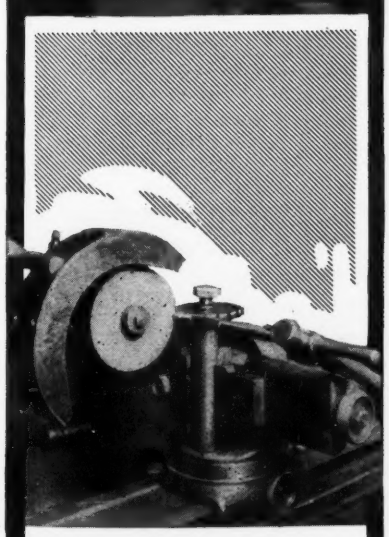
All Safety products are made of the best material by up-to-the-minute methods, and are furnished for a wide range of service.











Tool Grinding Series—No. 2

CUTTERS

Here are a few simple facts about cutter grinding.

The wheel must be of a soft, free-cutting grade; the cut must be light, and never forced.

The wheels most commonly used are about 46 grain, grades J and K; the coolest cutting abrasive is Alundum. Wheels finer than 60 grain should never be used for cutter grinding of either high speed or carbon steel. Fine wheels are more likely to burn the work than coarser wheels.

Some operators prefer to use a cup wheel whenever possible, since the periphery of a regular wheel leaves a clearance of the teeth slightly concaved or hollow. This may be overcome by swinging the machine table so that the work passes across the wheel at an angle instead of parallel to the wheel face, as shown in the set-up for the spiral cutter.

Practice varies as to the direction the wheel is run. It is safer to run the wheel off of the cutting edge. Some more experienced and skilled men in this work run the wheel toward the cutting edge, as there is slightly less danger of burning, and this method produces a keener cutting edge, free from burr. If the tooth is not held firmly against the tooth-rest by this method, the edge of the tooth may be carried into the wheel, causing it to be ground away.

We show here three general types of cutters and a practical set-up for grinding each. Note the first illustration—the tooth-rest must be set to give the clearance desired; it should be against the tooth being ground. Pass the cutter back and forth, merely touching one of the teeth, and watch carefully to be sure the machine is properly set to follow the "old clearance." When grinding, move the cutter past the wheel with a steady motion, taking light cuts, and use special care that the cutting edges are kept radially equal. The most difficult problem is to keep the cutter a true cylinder.

The average cut should not be more than from 0.001" to 0.002". Ordinarily, twice around will put the average cutter in condition.

The "setting" of the machine to obtain the correct angle of clearance is important. Too much clearance is better than too little—common practice is to allow four or five degrees for cutters. Cutters of the side mill type are ground on the top in exactly the same manner as the plain cutter. A cup wheel is employed for grinding the sides, the cutter being held on the edge of a special arbor, as shown in the illustration.

Form cutters are usually ground with a saucer or dish wheel. They are held on a short arbor, as illustrated here, and ground on the face only. It is important that the operator keeps the cutting edge in a radial line to retain the shape. In this particular type of cutter, it is necessary to do the grinding with the tooth-rest on the back of the cutting tooth instead of on the face.

For plain milling cutters, the wheels most used are Alundum 3846 J and K, although 3860 I, vitrified and silicate, is a popular grain and grade in saucer shapes, such as Brown & Sharpe No. 60.

One of the most popular wheels for grinding gear cutters is saucer shape Alundum 3846 K. Another good wheel is Alundum 3850 J. In the smaller diameters, 3860 K is commonly used.

On inserted tooth milling cutters, 3846 J and K are the most popular wheels, and under certain conditions 3836 I meets the requirements.

Other points to be kept in mind in connection with cutter grinding are:

The grinding wheel should run true.

The wheel should be kept clean—a glazed or dirty wheel will draw the temper quicker than one whose cutting surface is clean and true.

A diamond should be used for truing the wheel face.

Tool-room wheels should not be carelessly left lying around to collect oil and dirt, but should be kept in racks or cupboards designed for this purpose.

NORTON COMPANY
WORCESTER, MASS.

New York Store
151 Chambers Street

Electric Furnace Plants
Niagara Falls, N. Y.
Chippawa, Ont., Can.

Chicago Store
11 N. Jefferson Street

829

F. E. WELLS & SON COMPANY
Wells
GREENFIELD, MASS. U.S.A.

Capacity and Price of the Wells Rack Feed Grinder

Work up to 8" diameter and 16" long. Plain cutter and reamer grinder or extra attachments up to full universal. Price, $115 for No. 184 Rack Feed Grinder; $200 for No. 190 Grinder, illustrated, which is full universal.

The Wells
Rack Feed Grinder

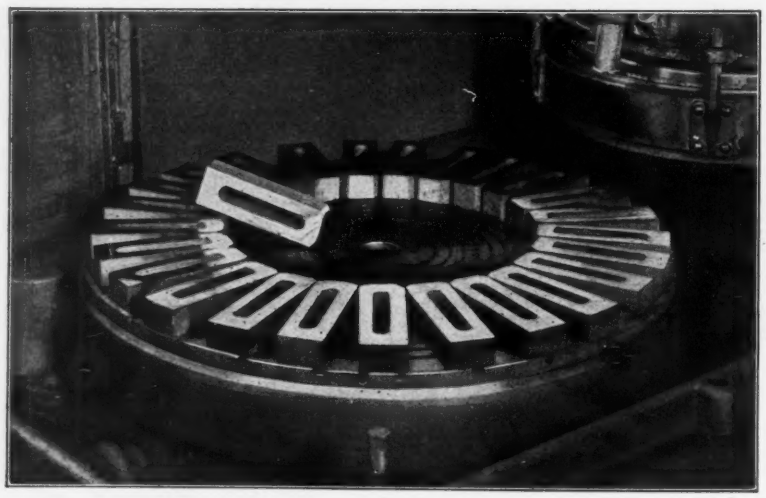
An all-round cutter and reamer grinder, moderate in price yet high class in every detail of construction and in service. The swivel table has vertical adjustment which permits working at any angle to the wheel. Slides have both horizontal and transverse movement, and top slide swivels for taper grinding. Spindle is ground, boxes and slides accurately fitted and dust-proof, and new spring-take-up compensates for end-thrust.

Complete details on request.

F. E. Wells & Son Company
Greenfield, Mass. U. S. A.

The Blanchard Grinder Saves Time and Money on these Castings

These jaws for lathe steady rests are 5¾″ long, 1¾″ wide, 1⅛″ thick. About 1-32″ is allowed on each surface for grinding. They are first ground on two sides parallel and to limits of ± .0015″ of size (this is the operation illustrated), then clamped in a simple squaring fixture holding 24 pieces where one edge is ground square, then put directly on the magnetic chuck again and the other edge ground parallel with the first and of course square with the two sides.



The production, grinding 4 surfaces square, parallel and to size limits of ± .0015″ is *25 castings per hour* (100 surfaces).

Compare the above with your practice. Wouldn't you like Blanchard production figures on your work? Write today.

The BLANCHARD MACHINE CO.
64 State St. Cambridge, Mass.

DOMESTIC AGENTS: Prentiss Tool & Supply Co., Motch & Merryweather Machinery Co., Marshall & Huschart Machinery Co., W. E. Shipley Machinery Co., Kemp Machinery Co., Robinson, Cary & Sands Co., Pacific Tool & Supply Co. **CANADA:** Williams & Wilson, Ltd., A. R. Williams Machinery Co., Ltd. **GREAT BRITAIN:** C. W. Burton, Griffiths & Co. **FRANCE:** Aux Forges de Vulcain.

The High Cost of Production

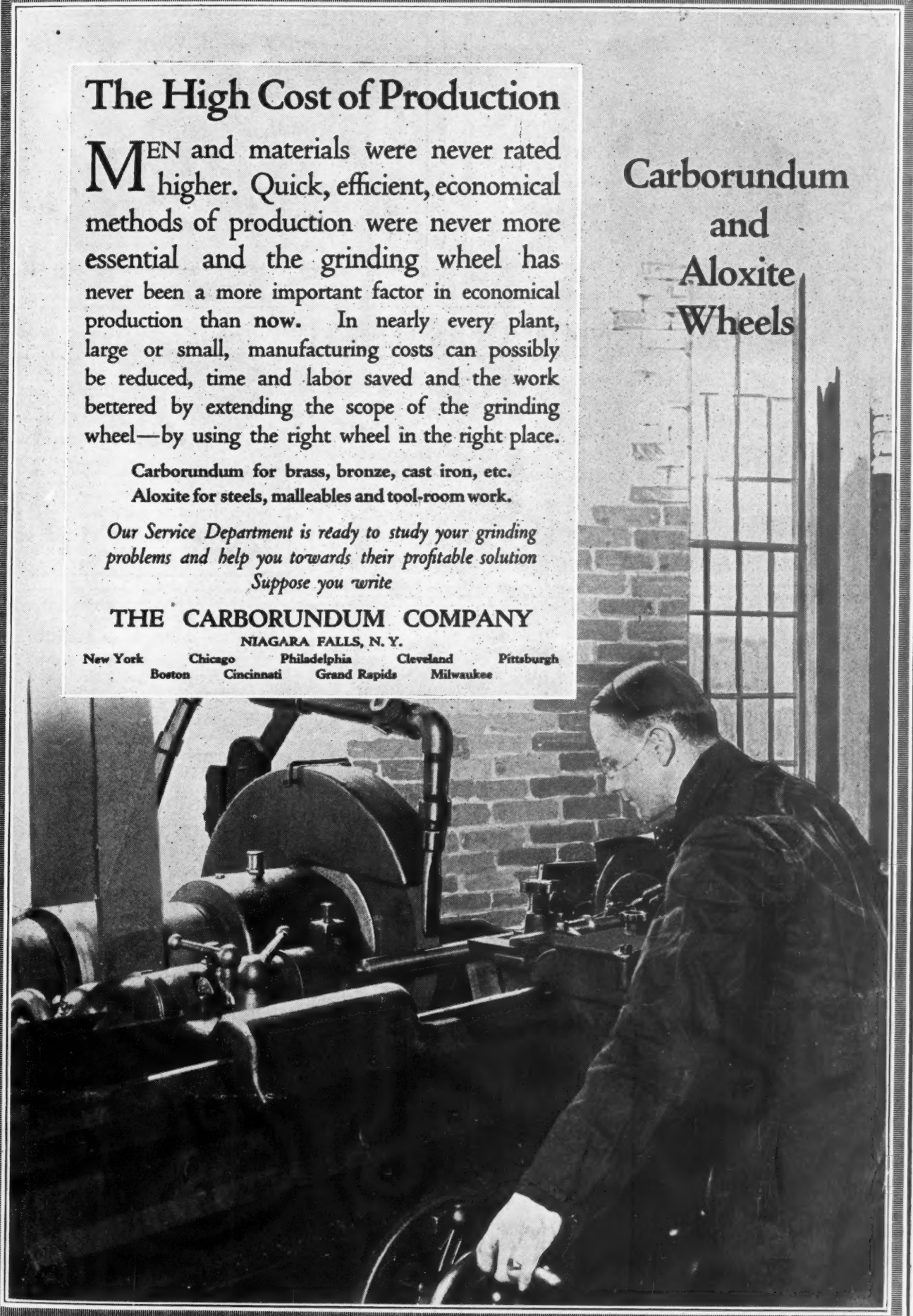
MEN and materials were never rated higher. Quick, efficient, economical methods of production were never more essential and the grinding wheel has never been a more important factor in economical production than **now.** In nearly every plant, large or small, manufacturing costs can possibly be reduced, time and labor saved and the work bettered by extending the scope of the grinding wheel—by using the right wheel in the right place.

Carborundum for brass, bronze, cast iron, etc.
Aloxite for steels, malleables and tool-room work.

Our Service Department is ready to study your grinding problems and help you towards their profitable solution
Suppose you write

THE CARBORUNDUM COMPANY
NIAGARA FALLS, N. Y.
New York Chicago Philadelphia Cleveland Pittsburgh
Boston Cincinnati Grand Rapids Milwaukee

Carborundum and Aloxite Wheels



Specify
Sterling Grinding Wheels

Made from best grade material according to proved methods. Can be depended upon for good work and long wear.
No matter what your work is, the wheel to grind it economically is listed in the "Sterling" line.

Write us your requirements.

THE STERLING GRINDING WHEEL CO.
Factories and Offices
TIFFIN OHIO

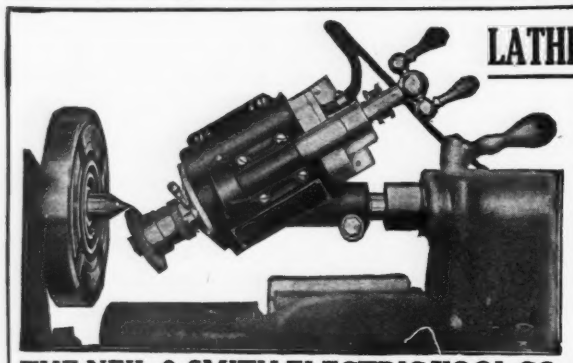
Selling Agency:
New York, 75 Barclay St.
Chicago Store, 30 N. Clinton St.

Bryant Chucking Grinder Company

Springfield, Vermont, U. S. A.

Builders of One, Two and Three Spindle Chucking Grinders.

LATHE CENTER GRINDER



Will grind lathe centers mechanically with scientific accuracy in fraction of time required with other methods.

Builders of "Ideal" Patented Portable Electric Tools, Grinders, Drills, Saws, Screw Drivers, Nut, Bolt and Lag Screw Setters.

Ask for Circular M.

THE NEIL & SMITH ELECTRIC TOOL CO., Cincinnati, Ohio, U.S.A.

THE MOTOR GRINDER
for
Machine Shops, Foundries Blacksmith Shops

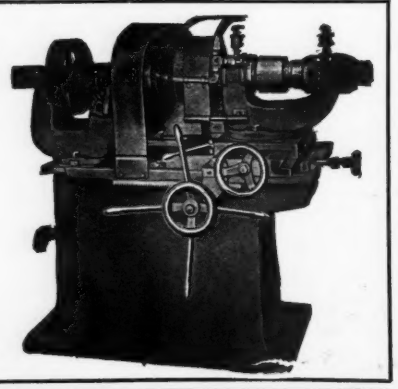
Simple, sturdy, durable grinders, built for service. Electrical parts enclosed in dust-proof covers; high-grade ball bearings used. Many other features.

Circulars sent on request.

FORBES & MYERS
178 UNION ST. WORCESTER, MASS.

The Bridgeport Grinder

A safe and sane little machine that cannot be bettered for accuracy, speed, range of work and simplicity. The big feature in operation is the Rotary Magnetic Chuck, which insures rapid production as well as accuracy. The Bridgeport is well built, easy to operate, and has arrangements to take up all wear as it occurs. *Let us send complete information.*



The Bridgeport Safety Emery Wheel Co., Inc.
BRIDGEPORT, CONNECTICUT, U. S. A.

Pedrick Tool & Machine Co.

Portable Cylinder Boring Bars
Crank Pin Turning Machines
Portable Millers, Pipe Benders, etc.

3639 Lawrence Street PHILADELPHIA, PA.

STAMFORD ROLLING MILLS CO.

Manufacturers of "Stamford Superior Stock" in
SHEET BRASS
GERMAN SILVER

Sales Office: 25 BROAD ST., NEW YORK

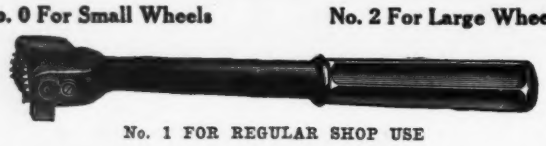
Radial Drills, High Speed Sensitive and Plain Radial Drills

Manufactured in sizes
2½, 3, 3½ and 4 foot by

The CARLTON MACHINE TOOL CO.
Successors to
The William E. Gang Company, Cincinnati, O.

EMERY WHEEL DRESSERS

No. 0 For Small Wheels No. 2 For Large Wheels



No. 1 FOR REGULAR SHOP USE

These Dressers in connection with our Cutters make a most powerful and efficient tool, especially our No. 0 for small wheels 6 inches and under, and No. 2 which is made proportionally larger and stronger for large wheels.

CUTTERS

We make the regular "Huntington" (pattern) for No. 0 and "Huntington" (pattern) Paragon Cutter and Roughing Cutter for Dresser No. 1 and the "Huntington" (pattern) and Roughing Cutters for Dresser No. 2. Let us send you descriptive circular and prices.

GEO. H. CALDER, Lancaster, Pa., U. S. A.

For keeping wheels in cutting condition

The "Diamo-Carbo" Emery Wheel Dresser

is not only more efficient than a diamond, but lasts longer and is so inexpensive that wheel-dressing costs are reduced to a minimum. Any one, sent on approval, prepaid. *Which size?*

No. 3—10" long....$3.50
No. 5—12" long....$4.00

DESMOND-STEPHAN MFG. COMPANY
URBANA, OHIO, U. S. A.
Alfred Herbert, Ltd., Coventry, England, Agents for Great Britain.

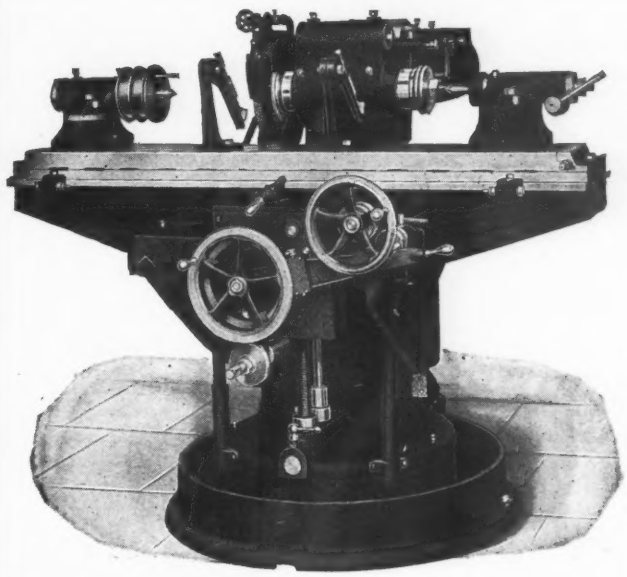
Use the Wheel You Can Depend On

VITRIFIED WHEEL CO.
WESTFIELD, MASS.

VITRIFIED GRINDING WHEELS

are tested under speeds that are more than three times greater than ordinary work requires. This practically makes it an impossibility for a defective wheel to leave our shops. Properly selected, Vitrified Wheels give unequaled service wherever used. All standard sizes, shapes and grades.

Catalog No. 8 for complete information.



An Ideal Grinder for the Small Shop

For the shop that has varied types of grinding to do and only a limited amount of each kind

The Thompson Grinder

is unsurpassed. Handles all kinds of grinding—plain, taper, surface, disk, die, tool and cutter—quickly and economically. Strong, sturdy and accurate. A machine you can always keep busy. An investment that will pay big dividends. Write for full details.

The Thompson Grinder Co.

Springfield, Ohio, U. S. A.

Blount Improved Wet Tool Grinder

Blount Grinders of every style are high grade throughout.

HERE is a grinding machine which can be run constantly if desired. It is exceptionally rigid and strong, has long, self-oiling bearings and a vertical centrifugal pump which guarantees a continuous and positively controlled supply of water. Overflow bowl is ample; safety hood protects the operator.

Ask your dealer or write for complete catalog.

J. G. BLOUNT COMPANY

EVERETT, MASSACHUSETTS

The Dillon Electric Grinder

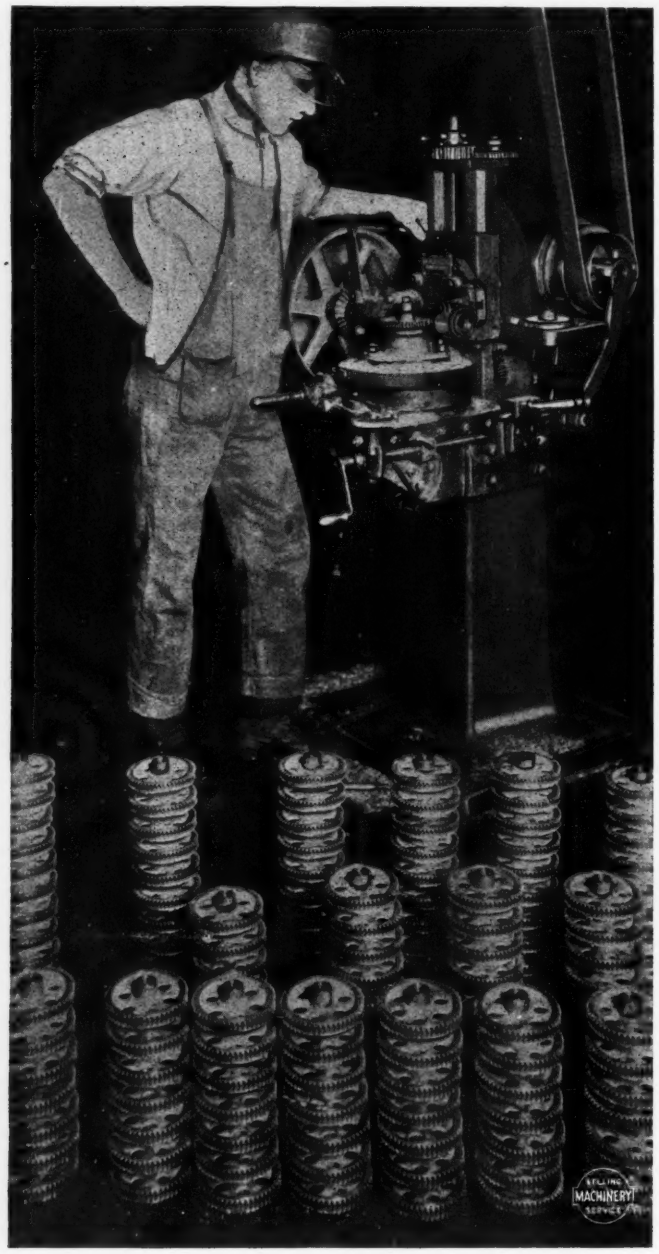
A machine adapted for tool grinding and a variety of other light tool-room and machine shop operations.

An especially designed, ruggedly constructed, dust-proof motor is one advantage of this machine. Ample wheel guards and grinding rests, efficient ball bearing equipment, accuracy and durability are others.

FULL DETAILS ON REQUEST.

The Dillon Electric Company

CANTON, OHIO, U. S. A.



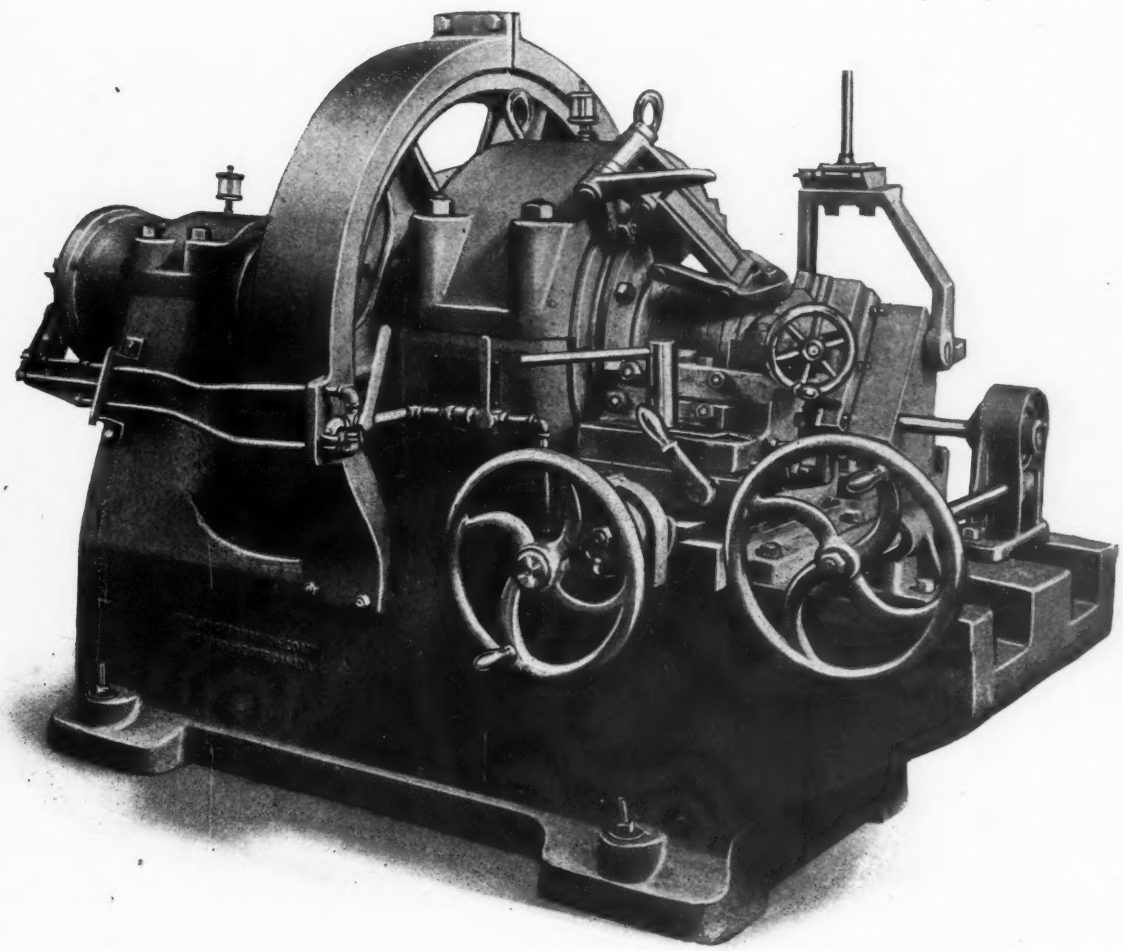
The Farwell Gear Hobber

This One We Believe Has Established a Record

FIVE years ago the Albaugh-Dover Company, Chicago, installed a No. 1 Farwell Gear Hobber. This machine has never been down for repairs—and much of the time it is run continuously from 12 o'clock midnight Sunday till 12 o'clock midnight Saturday. Mr. Navotny, General Foreman, estimates this machine has hobbed 175,000 gears, and today it is one of the smoothest running little mechanisms you ever saw. The work is 12 pitch, double thread, brass worm wheels; 4½" diameter, ⅝" face, 52 teeth. Output is 14 per hour, *every hour.*

There are several other Farwell Gear Hobbers in this plant. Do you wonder why?

THE ADAMS COMPANY, 1901 MARKET STREET DUBUQUE, IOWA



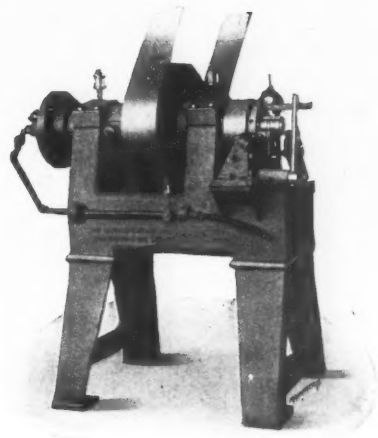
A Band Turning Lathe

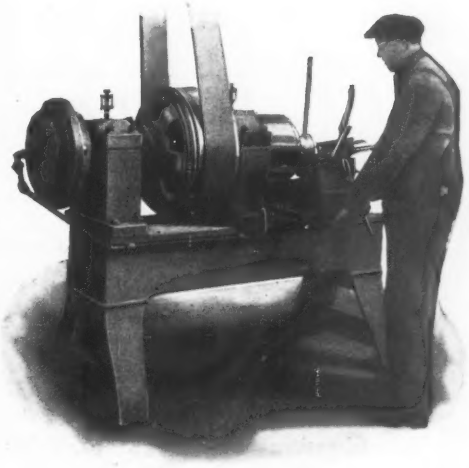
For 8", 9.2" and 12" British Shells

As Fast Comparatively as the Smaller Machines We Have Built

This machine is just about the last word in band turning lathes. Built big enough and powerful enough to handle 8″, 9.2″ and 12″ shells practically as fast as our smaller machines turn out the lighter shells. This machine will soon pay for itself in the amount of work it will do, comparing production by any other method.

Let us tell you more about these Band Turning Lathes and what they do. Built in sizes for shrapnel, 4.5″, 5″ and 6″ shells as well.

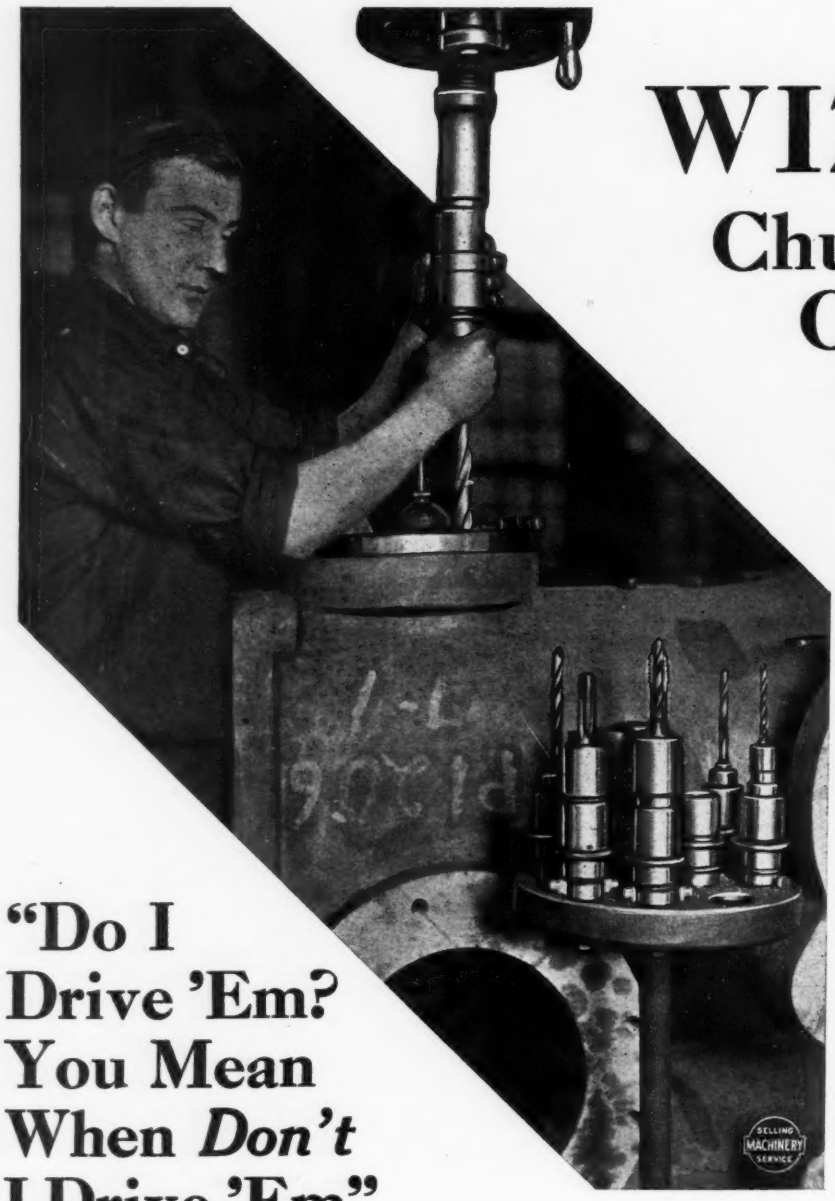




THE JENCKES MACHINE CO., Ltd.

Sherbrooke Cable Address "Challenge" **Quebec, Canada**

AGENCIES: Hull, England, Rose, Downs and Thompson, Ltd. Paris, France, Canadian and American Continental Agencies, 126 Rue de Provence. **SALES OFFICES:** Montreal, Toronto, St. Catharines, Vancouver, Cobalt.



WIZARD
Chucks and Collets

"Do I Drive 'Em? You Mean When *Don't* I Drive 'Em"

This operator drives his Wizard Chuck hard. He drills, reams, counterbores and taps these big pump castings, one after another. He changes from one hole to another, from one tool to another, but never stops the spindle of the machine. He gets big production and he gives full credit to the Wizard Quick Change Chuck, "the finest chuck in the world," he calls it.

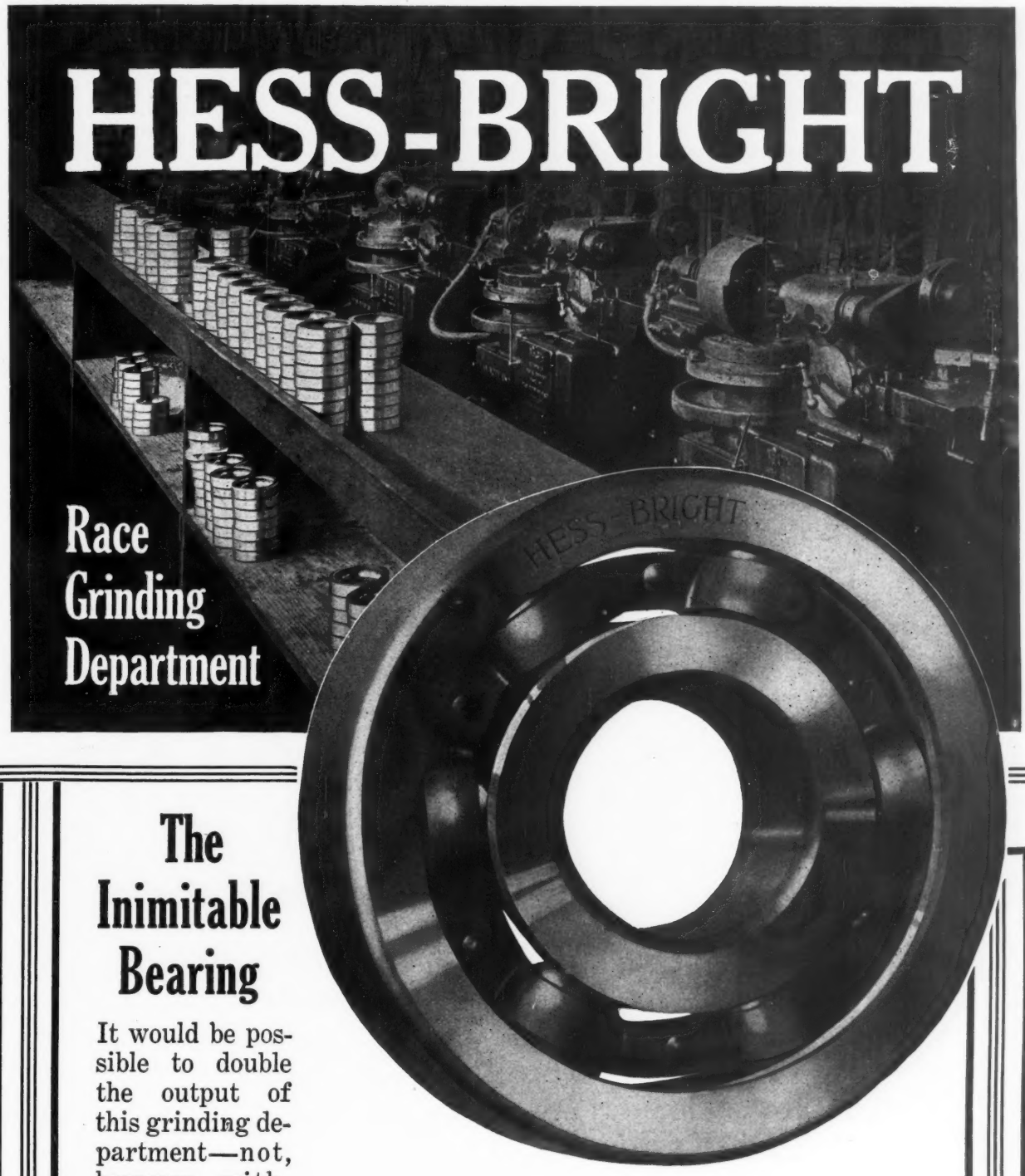
The Wizard Quick Change feature is the winning card. It means that different kinds and sizes of tools can be used in quick succession, that loss of time for making tool changes is minimized, and that changes are made without stopping the machine—it means, in short, faster work and lower costs.

Wizard Chucks are simple and dependable and adapted for lathe or boring machines as well as for drilling machines.

Sent on trial, to be returned at our expense, if not satisfactory. Give size of spindle hole, sizes and kinds of tools when ordering.

The McCrosky Reamer Company
Meadville, Pennsylvania

Export Agent: Benjamin Whittaker, 21 State Street, New York



The Inimitable Bearing

It would be possible to double the output of this grinding department—not, however, without sacrificing the quality of its output. In race grinding, close accuracy is extremely important—the ten-thousandth part of an inch is a lot; enough, in fact, to make or mar the bearing. The highest skill and the finest machinery are none too good to grind the races of "The Inimitable Bearing." Let us tell you more about them.

Hess-Bright's Conrad Patents are Thoroughly Adjudicated.

Hess-Bright Mfg. Co.

Front St. and Erie Ave. Philadelphia, Pa.

TRADE MARK
HB DWF
HESS-BRIGHT
THE INIMITABLE BEARING

Who Is Your Toolmaker?

**Bench Section
Gage Making
Department**

While the Work is in Progress

The opportunities for spoiling a piece of work in the making are almost countless—and you know it. Think, then, of the care which must be exercised in a plant such as ours, where difficult work of the highest grade only is performed.

We watch the progress of every job—men trained to this work are employed—the execution meets the requirements—the accomplishment is as nearly perfect as anything can be in mechanics.

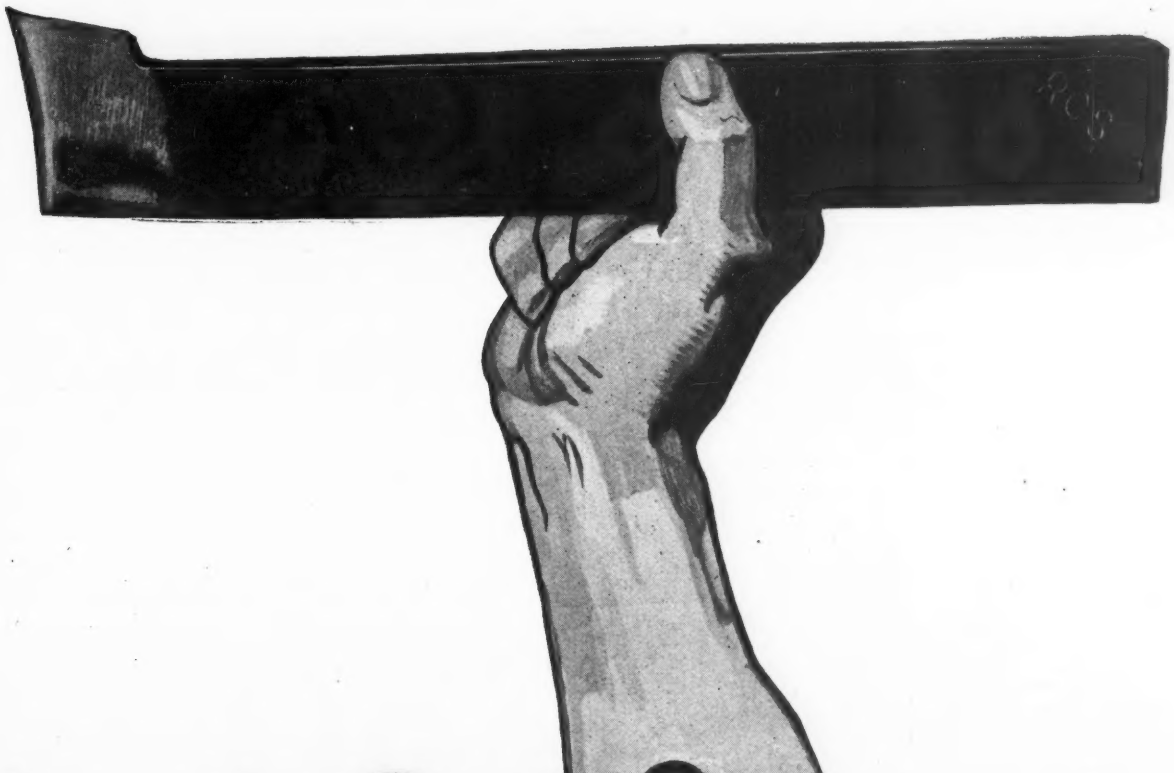
And this is the Krasco Idea—to do what we do right.

Whether it be designing and building machinery for special purposes; making gages, jigs, fixtures or tools essential for duplicate production; you may rest assured every step in the making is performed just so.

If you say 0.0002″ we work to 0.0002″.

This is service. It means profit to the concern that commissions us to KRASCO **do its work. Will you permit us to prove the profit for you?**

KRASBERG MANUFACTURING CO.
412-420 ORLEANS STREET CHICAGO, ILLINOIS, U. S. A.



"Red Cut Superior"

HIGH SPEED STEEL

YOU have thought of many qualities you would like to have in High Speed Steel Tools—such as cutting edges with long life, freedom from brittleness, great reserve strength and toughness to resist shocks and strains, tools that would not require special heat treatment, tools that would take deep roughing cuts or fine smooth finishing cuts, and in addition, could be worked at higher speeds than you ever dreamed of. All these virtues and many more are contained in "Red Cut Superior", a First Quality High Speed Steel. Furnished in Annealed Bar Stock, Discs and Treated Tool Holder Bits.

Send for folder.

Are your tools made of Red Cut ?

VANADIUM-ALLOYS STEEL CO.

Pittsburgh, Penna. Works at Latrobe, Pa.

Announcement

For years the expert pencil-lead craftsmen of Joseph Dixon Crucible Company have worked with one aim—*to produce an American-made drawing pencil that would set a new standard for the world.*

Exhaustive scientific research, years of practical experience and extensive experiments have at last accomplished the desired result. The new Dixon's Eldorado is "*the master drawing pencil.*"

This statement is not based on our opinion alone, but on the unanimous endorsement of leading engineers, architects, artists and draftsmen.

These men tested Dixon's Eldorado in unmarked cedar, compared it with other pencils they have used in all classes of pencil work, and declared it in every way equal to or superior to any drawing pencil on the market.

DIXON'S ELDORADO

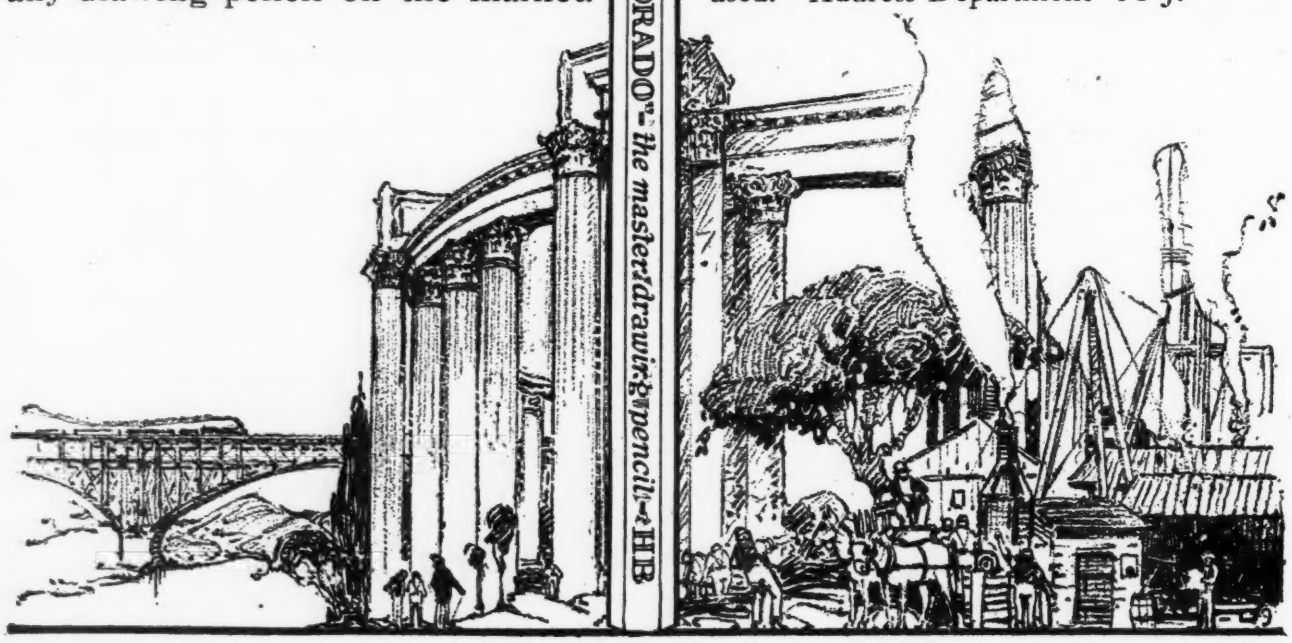
"the master drawing pencil"

It is comparatively easy to make a strong lead, or a long-wearing lead, or a smooth lead, or an evenly graded lead, but to combine all these points in a perfect balance is the finished work of America's leading lead-pencil manufacturers.

Use Dixon's Eldorado for all your pencil work. You will find the leads strong, responsive and long-wearing. Pencil bills will be reduced. Work will be cleaner, swifter and more satisfactory. Under no circumstances will Dixon's Eldorado fail to prove itself "*the master drawing pencil.*"

Made in 17 degrees, ranging from the soft, responsive leads in B's to the strong, long-wearing leads in H's.

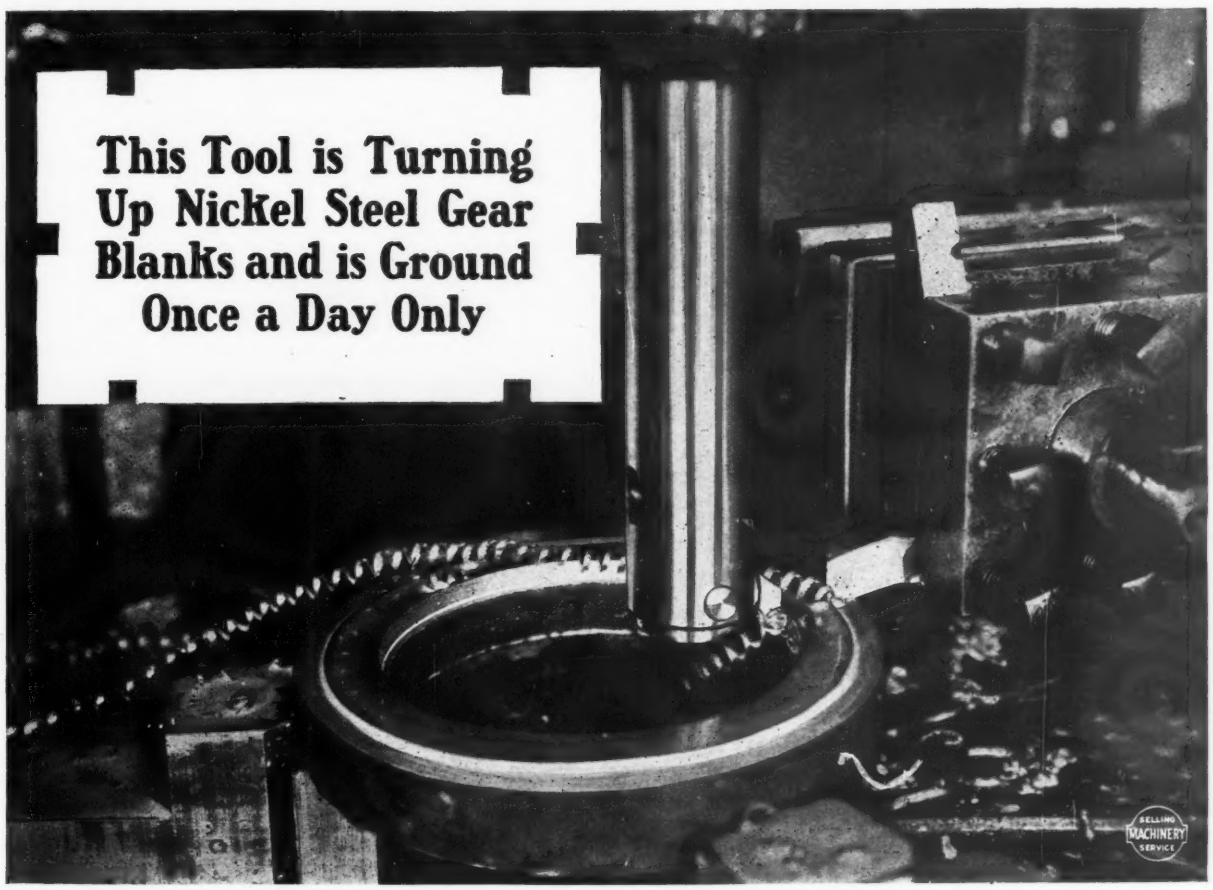
Full-size samples sent on request on your letter head; please specify degrees chiefly used. Address Department 74-J.



JOSEPH·DIXON·CRUCIBLE·CO·JERSEY·CITY·NJ.

WOLFRAM

TRADE HIGH SPEED STEEL MARK



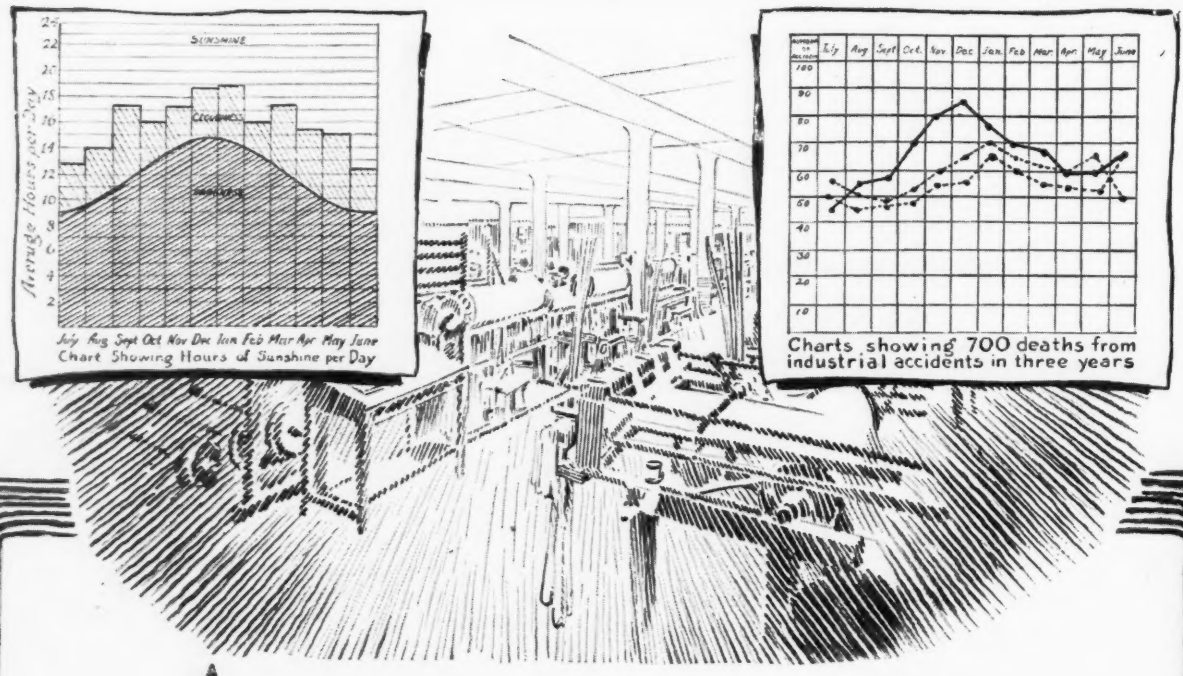
WOLFRAM—a Standard High Speed Steel CONTAINS 18% TUNGSTEN

All the elements entering into its manufacture are produced in America. It contains definite percentages of Tungsten, Chromium and Vanadium to give it the maximum cutting power with the fewest grindings.

***WOLFRAM** costs no more than other brands containing lower percentages of Tungsten.*

VULCAN CRUCIBLE STEEL COMPANY

ALIQUIPPA, PA., U. S. A.


Average Hours per Day
SUNSHINE
CLOUDINESS
July Aug Sept Oct Nov Dec Jan Feb Mar Apr May June
Chart Showing Hours of Sunshine per Day
Charts showing 700 deaths from industrial accidents in three years

ACCIDENTS
and their Relation to EFFICIENT LIGHTING

STUDY the charts. Note how the curve of accidents follows the curve of darkness. By far the greatest number of accidents occur during the dark months, the smallest number in the bright spring and summer months.

500,000—Not all accidents are avoidable, but the Manufacturers' Association states that 500,000 avoidable accidents have occurred in one year in the United States alone. Moreover, it is maintained by authorities, who have made a study of the safeguards for the benefit of employes, that 25 per cent of these accidents were caused by poor illumination.

SAFETY FIRST—Now, while a great deal is being done to safeguard the lives and limbs of employes, it must not be forgotten that efficient illumination is just as essential to safety as any of the safeguards already applied to belts, pulleys, etc.

THE COST—In many plants the cost of a great many accidents can—and should—be charged, directly or indirectly, to poor illumination. When this is done the real total cost of poor lighting is increased out of all proportion to the small cost necessary to prevent such accidents through the medium of efficient and sufficient lighting.

YOUR PROBLEM—Most managers realize this, but they differ among themselves on what constitutes good illumination. Since nearly every plant presents its own specific problems, the only safe thing to do is to get the advice of real lighting experts.

REAL SERVICE—The advice and co-operation of our experienced lighting engineers are at your service always. Learn from them the exact lighting requirements of your plant. It is our aim, in the interests of better lighting, to co-operate with you with the object of making your lighting not only the most efficient, but at the same time the most economical in the long run. Ask us any question you please. This exceptional service is based on the firm belief that, sooner or later, in the complete line of EDISON MAZDA LAMPS you will find the lamp or lamps exactly suited to your particular requirements.

EDISON LAMP WORKS OF GENERAL ELECTRIC COMPANY
HARRISON, N. J.

G030

The Height of Efficiency in Tapping

This operator is using an 8″ Murchey Collapsible Tap for boring out and tapping one end of a drain tee. He places the tee on the boring mill table, centralizes it carefully, clamps it down and starts the mill table. He then brings the Murchey Tap down to the work and throws in the downward feed.

This tap is equipped with a set of boring cutters placed in advance of the tapping inserts; the rough casting is carefully brought to size just ahead of the tapping operation, yet simultaneous with it. This method of handling a job of this nature is the height of efficiency. The boring and tapping is accomplished at the same time and the very best kind of thread is secured.

The length of the threaded portion is 1⅝″ and one tee is completed every six minutes—ten per hour. This includes setting up the work and taking it down. Six-inch tees, same length of thread, same conditions, are threaded at the rate of nineteen per hour.

A Big 8" Murchey Tap
Fitted with a Set of Boring Cutters

We'll send the catalogue and show you just what Murchey Tools—Collapsing Taps and Die Heads—can do to lower costs or better the quality of your threaded work, whenever you say the word. Why not write us now?

MURCHEY MACHINE & TOOL COMPANY
34 PORTER STREET, DETROIT, MICHIGAN

Great Britain, Ireland and British Colonies, Coats Machine Tool Company, Limited—LONDON—NEWCASTLE-ON-TYNE—GLASGOW. France: Fenwick Freres & Company, 8 Rue de Rocroy, PARIS.

IT'S A BAKER

BAKER BROTHERS
TOLEDO, OHIO, U. S. A.

BAKER MACHINES
In the Willys-Overland Plant

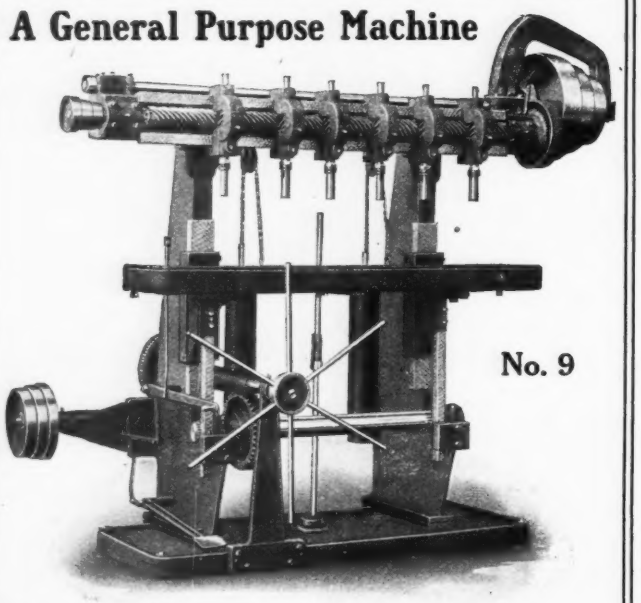
If you have drilling, reaming, counterboring, facing, etc., to do on malleable castings, cast iron, steel forgings, in fact on any material, let Baker High Speed Drilling Machines do the work. These machines handle that class of work which is usually done on the horizontal boring machine, but have the advantage over the horizontals in increased production and the smaller floor space required. Four Baker Drilling Machines occupy about the same floor space as an ordinary boring machine, and in addition will turn out more work *per spindle* than the boring machine.

The accompanying photograph shows a row of twelve Baker Drilling Machines in the Toledo plant of the Willys-Overland Co., working on steering knuckles, connecting rods and similar pieces. Just notice the small space occupied by these twelve machines—also the amount of work piled up around them to keep things going.

There are unequaled production possibilities in Baker Machines.

MAY WE DEMONSTRATE?

THE "HOLE HOG" LINE
A General Purpose Machine



No. 9

For bar and pipe work or for drilling several small pieces at once. Sliding jigs with working and loading stations can be supplied. Different heads adapt it to either light or heavy work. For light work it can be equipped to drill only ⅞" between centers—any number of holes desired. Ball thrust bearings and bronze bushings.

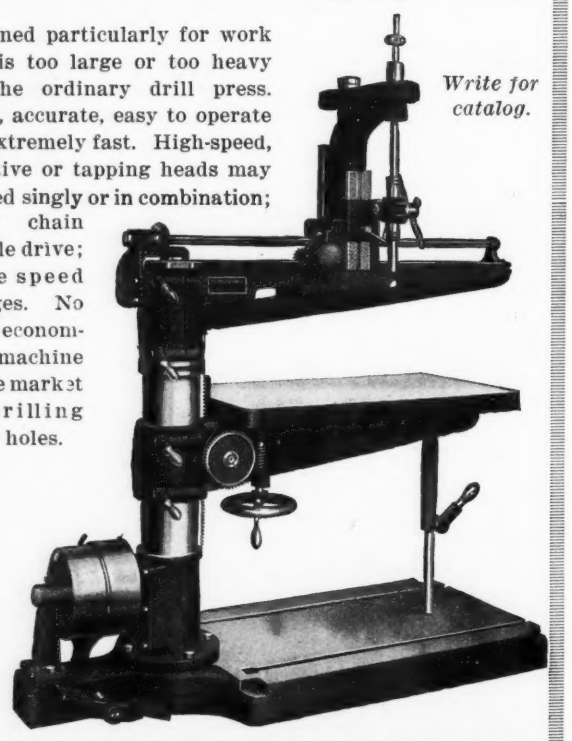
Made in 4, 5, 6, 8 and 10 ft. lengths; 8 and 10 ft. lengths have three columns.

MOLINE TOOL CO., Moline, Illinois
MULTIPLE DRILLERS AND BORERS FOR ALL PURPOSES

Try this Taylor & Fenn 3-ft. "Radial" for drilling ¾" holes

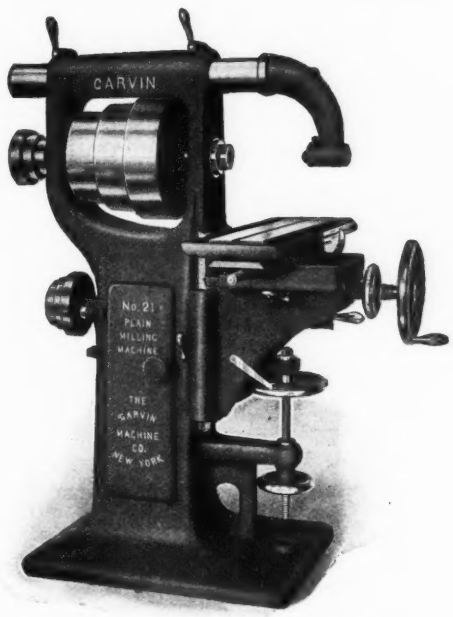
Designed particularly for work that is too large or too heavy for the ordinary drill press. Rigid, accurate, easy to operate and extremely fast. High-speed, sensitive or tapping heads may be used singly or in combination; silent chain spindle drive; three speed changes. No more economical machine on the market for drilling small holes.

Write for catalog.



THE TAYLOR & FENN COMPANY
HARTFORD, CONN., U. S. A.

A GARVIN MILLING MACHINE FOR EVERY NEED



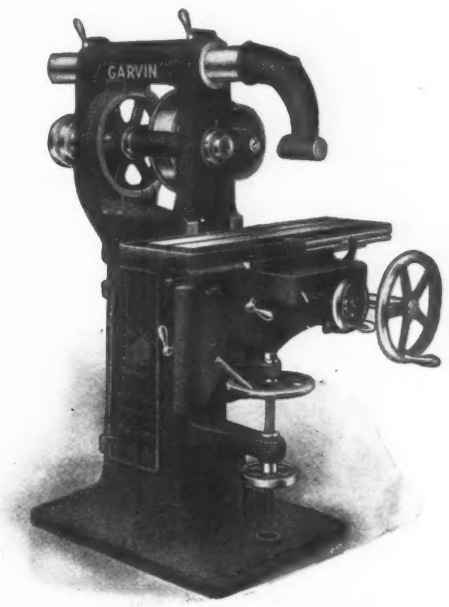
GARVIN No. 21 Plain Milling Machine
Use Code - - Absorb

Fully 80% of the Milling Machines manufactured are used on manufacturing work, and a great majority of this 80% is used on what is called long set-ups. Did it ever occur to you that a simple Milling Machine without frills is made just as accurately as the so-called standard machine, and would effect a great saving in the first cost of your machine tool equipment?

Again, a less expensive operator can be used.

Think this over and investigate the merits of our No. 21 and No. 22 Plain Milling Machines—made especially for manufacturing work and used by large concerns in gangs of six, to one operator.

Machines are simple and accurate, having lots of power, and enough feed and speed changes to take care of the work they are intended for.



GARVIN No. 21 Plain Milling Machine, Back-Geared. Use Code - - Abject

Ask a GARVIN User

FOR FURTHER INFORMATION { ASK YOUR DEALER OR WRITE US DIRECT

Send for Complete Catalog

MANUFACTURED BY

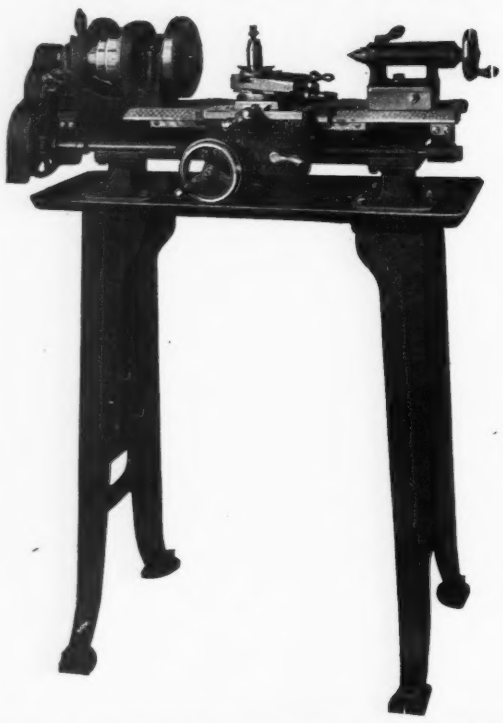
THE GARVIN MACHINE COMPANY

Spring and Varick Streets **50 Years in NEW YORK CITY**

VISITORS WELCOME

Economical Work on Small Lathes

The Dalton 6-inch x 30-inch



Actual swing 7¼ in., New Model B-4, is specially designed to handle small work with the greatest possible economy, at the same time it has ample strength to do work often done on lathes three or four times its size.

The Dalton saves money on quantity production, and it has the requisite accuracy for tool-room and other precision work. Thread cutting range from 3 to 144 per inch.

Bulletin B-602 is ready

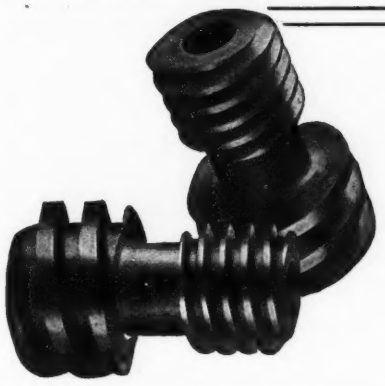
DALTON MACHINE COMPANY, Inc., 1911 PARK AVE. NEW YORK

The Flather Quick Change Gear Lathe

Latest and Best.
Strong and Simple.
Least number of Gears.
Greatest number of Threads and Feeds.

Send for descriptive circular.

FLATHER & COMPANY
INCORPORATED
NASHUA, NEW HAMPSHIRE

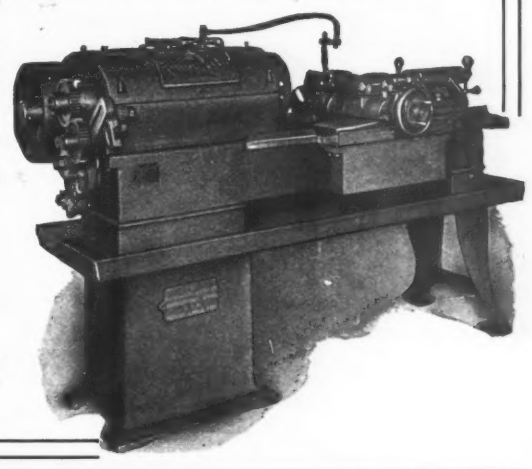


On Work Like This You Can't Beat "The Automatic"

for speed, accuracy and uniform results. A double thread with different leads and diameters would prove a difficult and expensive job to handle on an ordinary lathe. No trouble for the Automatic Threading Lathe—it finished the pieces complete in 5 minutes each. Could you duplicate this time by any other method?

Saves from 75 to 90% on Your Threading Costs

This wonderful time saver performs every operation automatically. Turns out threads of all kinds, square or angular, with surprising rapidity and extreme accuracy. Another big point—one operator can attend to several machines. We can show you how to reduce your threading costs.



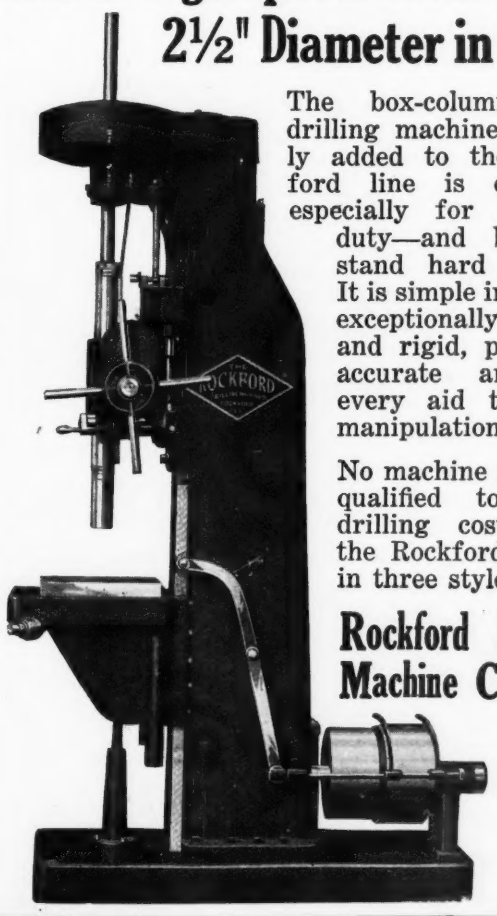
Send blueprints or samples.

AUTOMATIC MACHINE CO.

BRIDGEPORT, CONNECTICUT

AGENTS: C. W. Burton, Griffiths & Co. of London, England. Marshall & Huschart Machinery Co. of Chicago, Ill. Motch & Merryweather Machinery Co. of Cleveland, O., and Vandyck Churchill Co. of New York.

Drives High Speed Drills up to 2½" Diameter in Steel



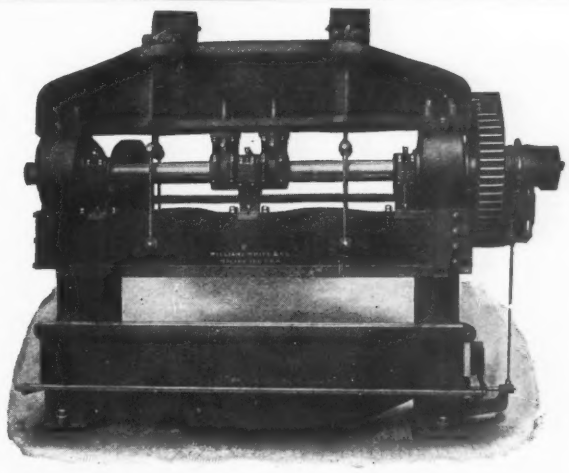
The box-column type drilling machine recently added to the Rockford line is designed especially for heavy duty—and built to stand hard service. It is simple in design, exceptionally strong and rigid, powerful, accurate and has every aid to rapid manipulation.

No machine is better qualified to lower drilling costs than the Rockford. Built in three styles.

Rockford Drilling Machine Company

Rockford, Illinois, U. S. A.

Write for complete description.



Multiple Punches and Gate Shears

in a Wide Range of Lengths and Capacities

We also build a complete line of Rapid-running Power Presses, Tie Rod Presses, as well as Straight-sided Trimming Presses and a complete line of Forging, Punching and Shearing Machinery. *Write for description.*

Williams, White & Co.

Moline, Ill. U.S.A.

Pittsburgh Office 808 House Building

Chicago Office 933 Monadnock Block

THE WHITON

REVOLVING CENTERING MACHINE

FOR ACCURATELY CENTERING FINISHED SHAFTS

The cut shows new **Revolving Centering Machine**—a large size of the well-known machine of this type. It is heavier throughout and has capacity to center shafts up to 5 inches in diameter.

Constructed same as the smaller machine and embodies all the special features.

Circulars and prices sent upon application.

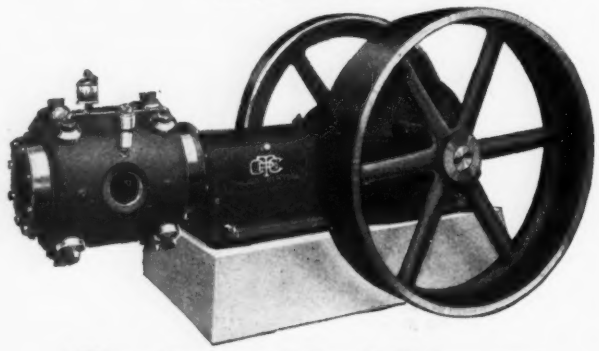
THE D. E. WHITON MACHINE COMPANY

NEW LONDON, CONNECTICUT, U.S.A.

"Chicago Pneumatic" Compressors

Steam and Belt Driven

Single Enclosed — Self Oiling — Equipped with Simplate Valves



"Chicago Pneumatic" Class N-SB Compressor

Unquestionable reliability, sustained low operating costs, totally enclosed construction and efficient automatic lubrication and regulation of "CHICAGO PNEUMATIC" CLASS N-SB AND N-SS COMPRESSORS are features which combine to give them an individuality that justifies their selection by discriminating purchasers.

These compressors are fitted with our patented "Simplate" Disc Valves which have proven after prolonged tests under severe conditions to give a minimum clearance and afford a higher volumetric efficiency than is usually obtainable with small compressors.

For full information and prices address

CHICAGO PNEUMATIC TOOL COMPANY

1060 Fisher Bldg. CHICAGO — 52 Vanderbilt Ave. NEW YORK

Branches Everywhere

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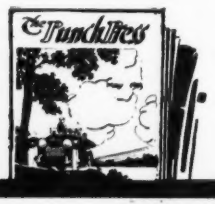


DO YOU GET IT?

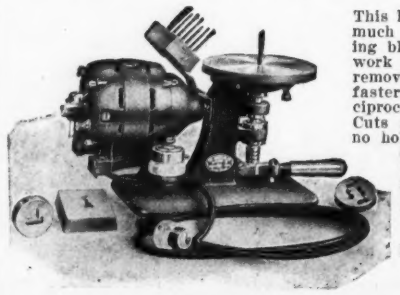
A monthly nugget of food, sunshine and entertainment. The man who edits it writes it as a pleasure—not as a duty. Sent free to anyone anywhere without obligation.

Send us your name and address and mention MACHINERY.

THE GLOBE MACHINE & STAMPING CO.

CLEVELAND, OHIO

The Anderson Die Forming Machine



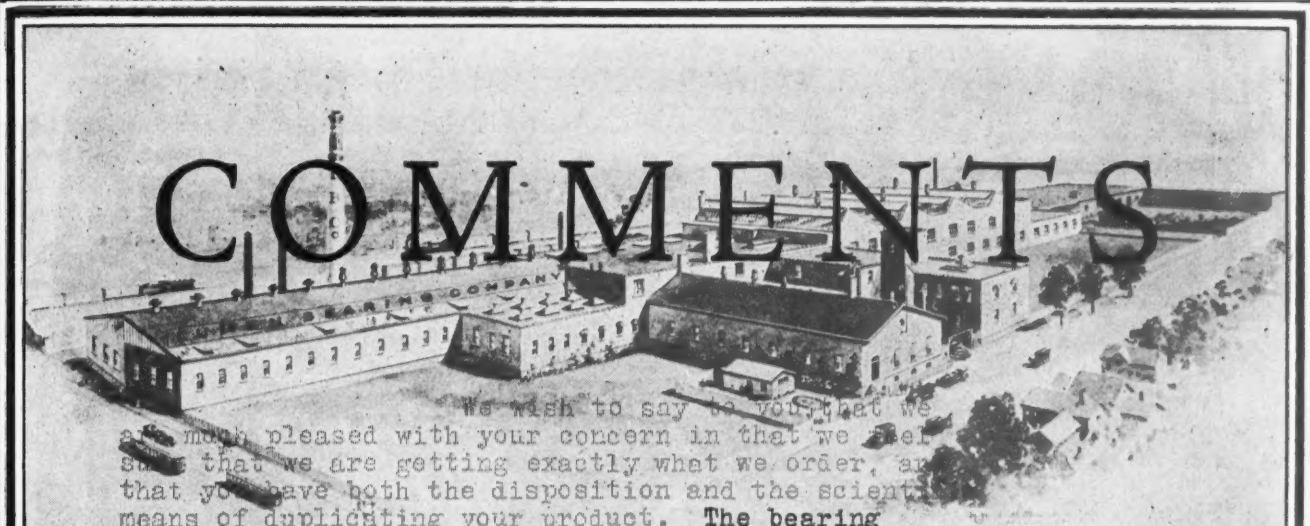
This handy little device saves much valuable time in finishing blanking dies and similar work after the core has been removed. It does the work faster and better than a reciprocating filing machine. Cuts constantly, and requires no holding fixtures or change of tools to finish the various surfaces. Any desired clearance can be cut without extra work. Motor driven.

Send for Bulletin No. 1 —gives full details.

THE ANDERSON DIE MACHINE CO.

BRIDGEPORT CONN., U. S. A.

COMMENTS



We wish to say to you that we are much pleased with your concern in that we feel sure that we are getting exactly what we order, and that you have both the disposition and the scientific means of duplicating your product. **The bearing bronze that we are using at present, so far as the light of our experience has taught us, is the best we have ever used.**

QUALITY

In the past we operated a brass foundry making our bronze and brass castings at [illegible], but the excellent **quality of the castings and the prompt service given us by your company made it much to our advantage to shut down our own foundry and to place our orders with you.**

ECONOMY

We are however pleased to state that we have used this metal continuously for the past ten years in making the most important bearings [illegible] we build. Judging from our own experience and [illegible] customers using our machines, **we believe you are furnishing material that we need not hesitate to put into the construction of the high grade machinery which we endeavor to manufacture.**

CONFIDENCE

THE *Quality* of our castings and the *Economy* derived from their use will inspire your *Confidence* in our product.

We will gladly send you complete letters from which the above comments are taken, upon request.

LUMEN BEARING COMPANY

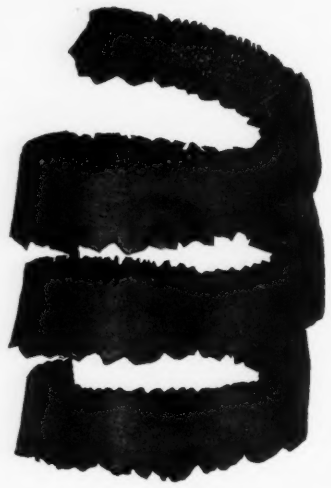
BRASS FOUNDERS

BUFFALO

JESSOP'S "ARK" HIGH SPEED STEEL

Has an Unexcelled Record. **Note the Following Facts.**

In turning 100 railway car wheel tires, Jessop's "Ark" High Speed Steel has the record of losing less steel, due to grinding, than any other make.



The actual amount of steel ground off the tool in turning 100 wheels was 3 ounces. This is an unrivalled performance in steel economy.

We have a large stock of Carbon Tool Steel and High Speed Steel. Write for Catalogue.

WM. JESSOP & SONS, Incorporated

91 JOHN STREET, NEW YORK, N. Y.

Boston Warehouse: 163 High Street **Branch Warehouses throughout the United States**

DRILL VISE

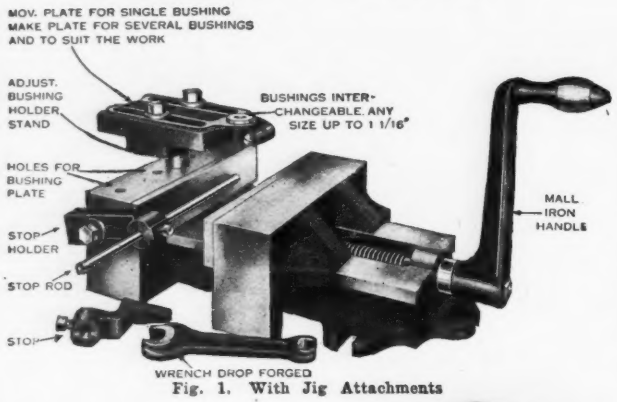


Fig. 1. With Jig Attachments

Always a good vise for general shop use on driller, miller, shaper or planer, and at the same time holds work for duplicate drilling without the cost of a jig.

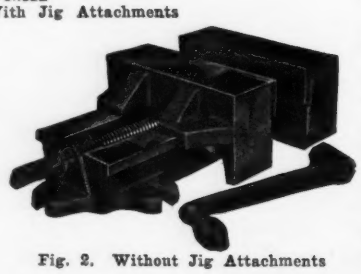


Fig. 2. Without Jig Attachments

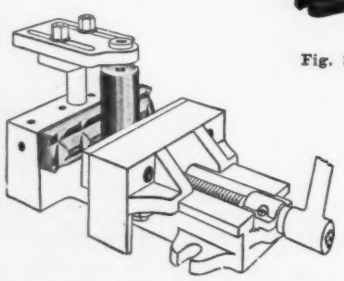


Fig. 3. V-Jaw for Round Work

VISE

No. 3, jaws 6", opens 4½", with attachments, $22.00; without, $20.00. List.

No. 4, jaws 9", opens 7", with attachments, $27.50; without, $25.00. List.

No. 5, jaws 12", opens 9½", with attachments, $40.00; without, $36.00. List.

DRILL SPEEDER

No. 2, with chuck, drills 0" to 5/16". List, $25.00.

No. 3, with chuck, drills 0" to ½". List, $27.50.

No. 3B, with No. 1 Morse hole instead of chuck, $27.50.

No. 4, with chuck, drills 0" to ¾". List, $40.00.

No. 4B, with No. 2 Morse hole instead of chuck, $33.00.

No. 2L, with chuck, drills 0" to ¾". Has feed lever mechanism. List, $33.00.

All Patented. Send for Circular.

The Graham Mfg. Co.

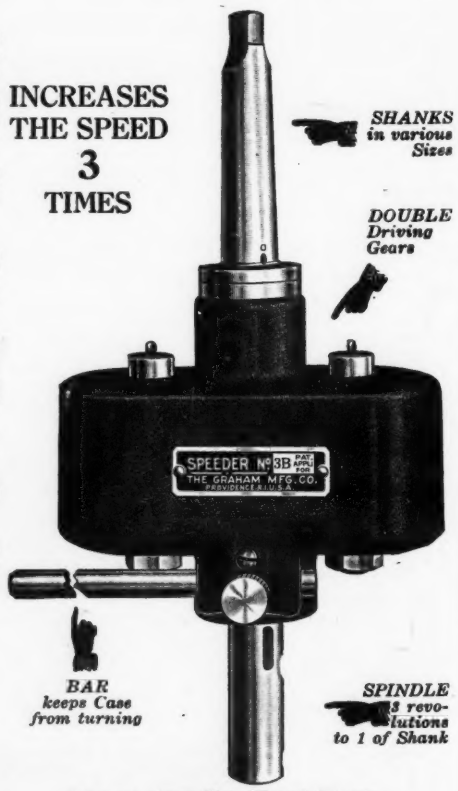
Providence, Rhode Island

Great Britain: C. W. Burton, Griffiths & Co. **Germany, Austria-Hungary, Scandinavia:** A. Kayser, Berlin, S. W. 68. **France, Belgium, Italy, Switzerland, Spain and Holland:** Fenwick Freres & Co., Paris.

DRILL SPEEDER

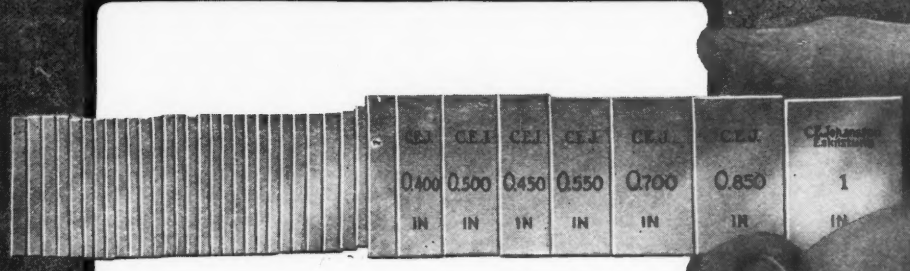
For Use in Drillers from 20-inch to Largest Radial
For Twist Drills 0" to 3-4" requiring speeds up to 3000 R. P. M.

INCREASES THE SPEED 3 TIMES


SHANKS in various Sizes
DOUBLE Driving Gears
SPEEDER No 3B
THE GRAHAM MFG. CO.
PROVIDENCE R.I. U.S.A.
BAR keeps Case from turning
SPINDLE 3 revolutions to 1 of Shank

This cut shows Nos. 3B and 4B only. There are two other styles and sizes.

Accuracy Beyond Question

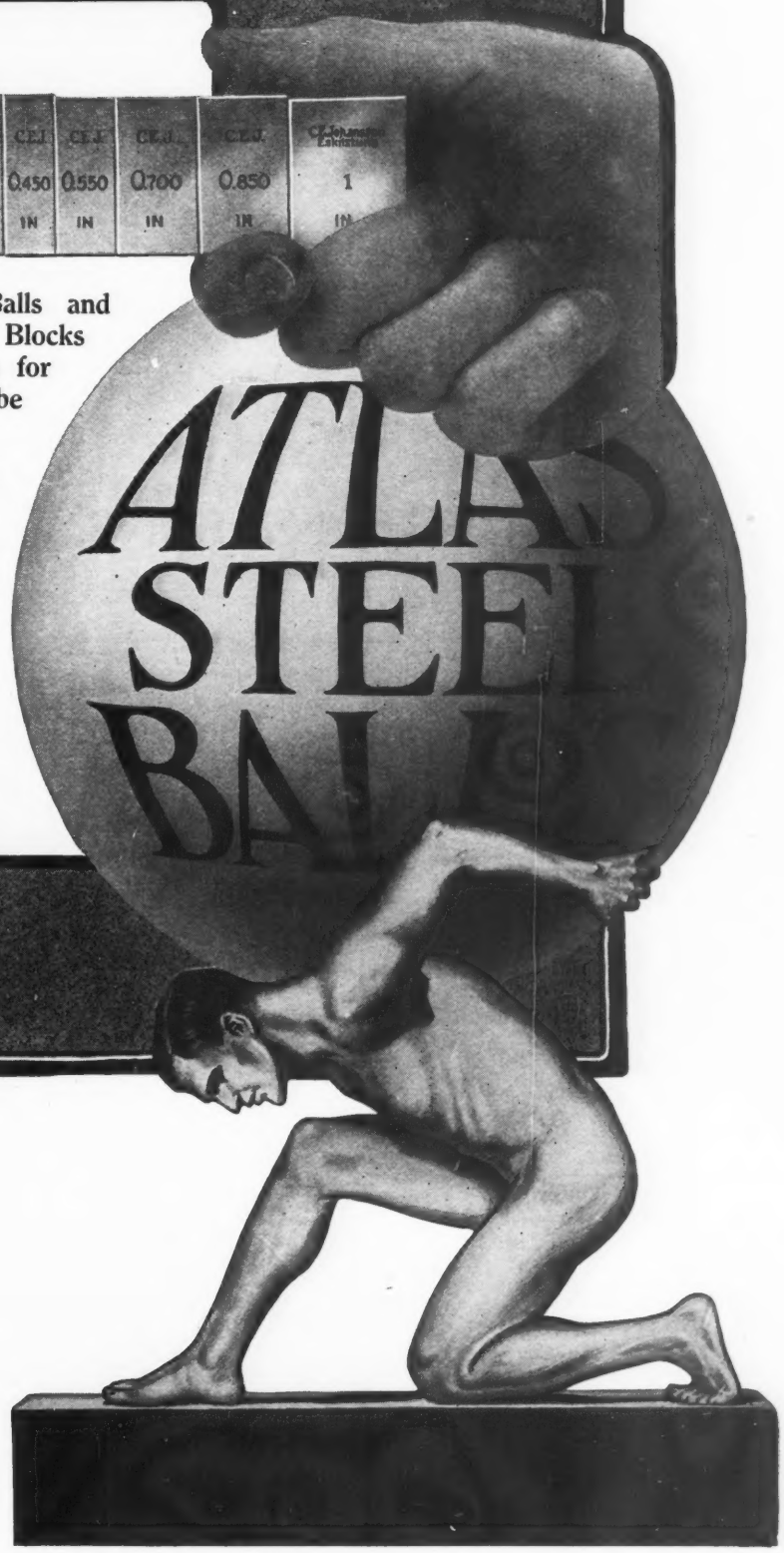


ATLAS Steel Bearing Balls and the Johansson Gauge Blocks are the accepted standards for accuracy. They both can be depended upon.

A ball bearing with Atlas Balls in the raceways is the final word in high-class mechanical engineering.

They cost more, but they are worth it.

ATLAS BALL COMPANY
Glenwood Ave. at Fourth St.
PHILADELPHIA, U. S. A.



Disston Interlocking Inserted-Tooth Metal-Cutting Saw

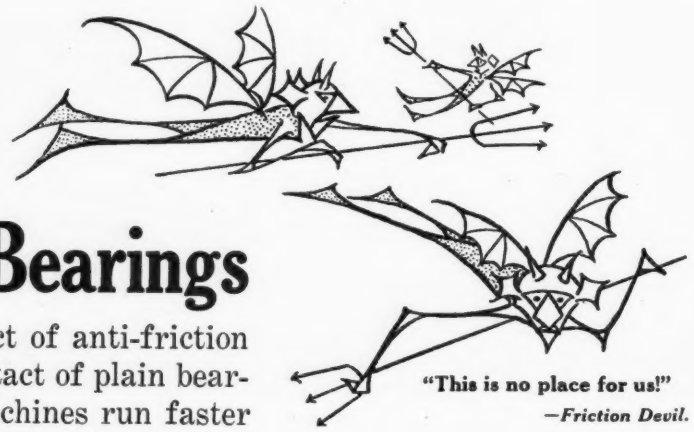
Made in two styles: Adjustable Base and Solid Base.
(Illustration shows adjustable base.)

HENRY DISSTON & SONS, Inc., Philadelphia, U.S.A.

"Anti-Friction Bearings on the Job. Friction in Full Flight!"

That's the report from shops we have equipped with

Ball and Roller Bearings



"This is no place for us!"
—*Friction Devil.*

It means that the free rolling contact of anti-friction bearings has replaced the sliding contact of plain bearings; that friction is eliminated; machines run faster and work longer; power is conserved; output is higher; wear is minimized; that the money friction wasted is saved.

The anti-friction bearings supplied by us are practically indestructible, accurately made, finely finished, guaranteed bearings, adapted for light or heavy duty, for high or low speeds.

Write us your requirements.

The Ball & Roller Bearing Company
DANBURY, CONNECTICUT, U. S. A.

"NORMA"

SILENCE, speed and service—aren't these the three things you are seeking in your high-speed bearings? You'll find them, in highest degree, in "NORMA" High-Precision Bearings—as has been conclusively proved by the performance of hundreds and hundreds of thousands of "NORMA" Bearings in high-speed, high-duty machines.

Have you the Catalog?

THE NORMA COMPANY OF AMERICA
1790 BROADWAY NEW YORK

Ball, Roller, Thrust and Combination Bearings

An Advantage in Price
IS OBTAINED WHEN YOU USE THE
National-Cleveland Counterbore

While the cutter is made of the highest grade high speed steel, the shank and pilot are made of lower grade steel, reducing the production cost.

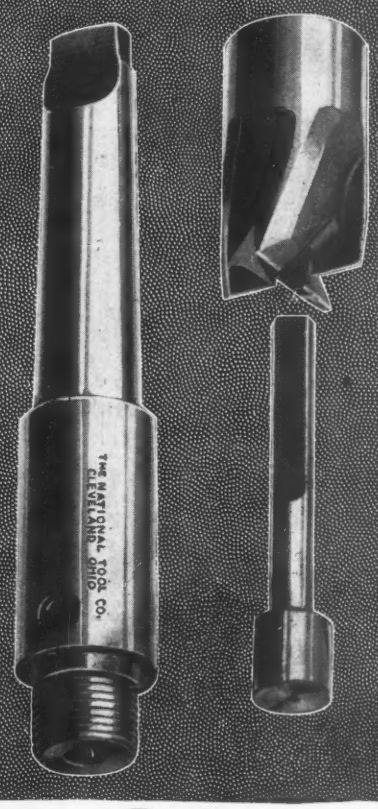
The hole for the pilot in both the cutter and holder is ground to insure a good fit for the pilot shank.

The cutter has an unusually long life, due both to the highest grade of steel used, and the fact that the spiral flutes extend back so that the cutter may be used until two-thirds has been worn away.

WRITE FOR PRICE LIST—ASK US ALSO ABOUT THE NATIONAL-CLEVELAND CUTTERS

Immediate Delivery

On all standard stock — Quick service on special work.

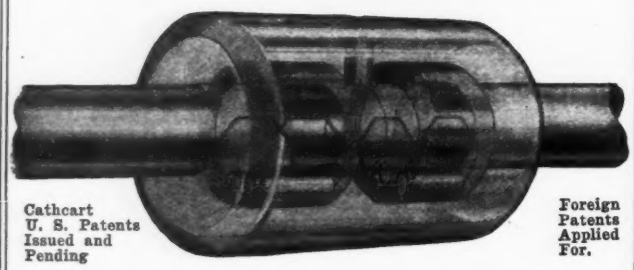


The NATIONAL TOOL CO.
CLEVELAND, OHIO.

The Price of Safety

is too low to justify you in using old-style, dangerous, man-killing flanged couplings in your plant instead of

Bull Dog Shaft Couplings



Cathcart U. S. Patents Issued and Pending

Foreign Patents Applied For.

The Bull Dog Coupling holds the shaft in an unbreakable grip, yet can be detached in an instant, if necessary. It is absolutely free from any projection which could possibly cause accident to employes or equipment.

The construction is the essence of simplicity. Just a smooth metal cylinder containing two eccentric chambers equipped with steel rollers which grip the shaft. No wrench, no screws, no tools of any kind are needed to apply this coupling—you can put it on with your two hands and it locks automatically and stays locked with the load. As there is nothing to wear or break there is nothing to repair.

If you are in any way responsible for the efficiency of a plant or the welfare of its employes, you should know all about this coupling which has been in successful service without a single failure for the past six years.

BULL DOG SHAFT COUPLING TRADE MARK REGISTERED

The booklet goes into detail. Write for your copy today.

Automatic Shaft Coupling Co.

Manufacturers

ALEXANDRIA, VA.

Supply Houses Carrying Stock

Charles H. Newman	New York City
Central Distributing Co.	Detroit, Mich.
Central Distributing Co.	Jackson, Mich.
Codd Tank & Specialty Co.	Baltimore, Md.
Diamond Specialty & Supply Co.	Philadelphia, Pa.
Culpepper Machine Co., Inc.	Culpepper, Va.
Ryther & Pringle Co.	Carthage, N. Y.
Standard Supply & Equipment Co.	Trenton, N. J.
Macan, Jr., Co.	Easton, Pa.
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Turner Supply Co.	Mobile, Ala.
The Union Iron Works Co.	Selma, Ala.
Carolina Supply Co.	Greenville, S. C.
Fulton Supply Co.	Atlanta, Ga.
Montgomery & Crawford	Spartanburg, S. C.
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Crawford Mill Supply Co.	Winston-Salem, N. C.

72-30

Caldwell Friction Clutches for Unusually Hard Service

We manufacture several types, each of which is suited for specific purposes. The type shown is adapted for rough and severe uses when the starting twist is great, and when operated by unskilled mechanics.

With our line of Double Disc Clutches, Caldwell Standard Clutches and Contracting Ring Type Clutches, we can surely find one to suit your requirements. The design of our clutches is the result of 40 years' experience, and if you will send your clutch problems to us, we will be glad to make recommendations. *Catalog No. 38.*

H. W. CALDWELL & SON CO.

Elevating, Conveying and Power Transmitting Machinery

17th Street & Western Avenue, CHICAGO

711 Main Street, DALLAS, TEXAS

50 Church Street, NEW YORK, N. Y.

Abbott Quality Steel Balls

Made of high-grade steel, finely finished, extremely accurate, and guaranteed for lasting service.

Quality Balls for Quality Service

Write for quotations. Complete line of other grades also.

The Abbott Ball Company

Elmwood

Hartford, Conn.

Dart Unions for a Perfect Joint

Double bronze seats prevent any possibility of rust or corrosion; malleable iron pipe-ends and heavy shoulder insure strength and durability. Dart Unions are permanent—longer-lived than the pipes they connect.

E. M. DART MFG. CO.

PROVIDENCE RHODE ISLAND

The Fairbanks Co., Sales Agents.
Dart Union Co., Ltd., Toronto, Can.

Samples on request

ROYAL COTTON AND WOOL WASTE — OUR WASTE IS YOUR GAIN — Trade Mark Reg. U.S. Pat. Off.

and your gain is our Waste

A many-sided gain, because
"ROYAL" WASTE

is a Standardized article, carefully manufactured to do the most and best work at the smallest possible cost. It is extremely absorbent and carefully refined of dust, dirt and splinters.

Guaranteed for

(1)—QUALITY—as per sample
(2)—"TARE" (wrappings)—only 6% or refund
(3)—WEIGHT—as ordered

Baled compactly and handily in light clean burlap, with new steel bands.

Ask your jobber or write for Royal Sampling Catalogue No. 26 showing 12 grades (6 white, 6 colored) of Cotton Waste; or ask for samples of Royal Wool Waste.

ROYAL MANUFACTURING Co

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Chicago Office - Peoples Gas Bldg. St. Louis Office - Railway Exchange Bldg.
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LOOK FOR THE BRAND ON EACH STEEL BAND

ROYAL COTTON AND WOOL WASTE — OUR WASTE IS YOUR GAIN — Trade Mark Reg. U.S. Pat. Off.

Registered
Trade Mark

There are Now 46 Years to the Credit of Carpenter Taps

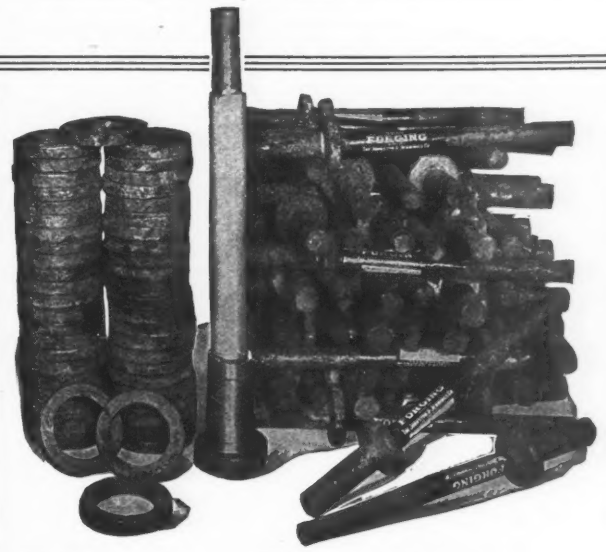
They are the oldest taps on the market; they have been successful from the start; there are none better to be had now.

Carpenter Taps get their working and wearing qualities from the combination of selected materials, special method of hardening and expert workmanship. Try them for both accurate, clean-cut threads and for lowering costs.

Catalog on request.

THE J. M. CARPENTER TAP & DIE COMPANY
PAWTUCKET, RHODE ISLAND

Alfred Herbert, Ltd. (Coventry, England), Great Britain. Schuchardt & Schutte, Berlin, Shanghai, Vienna, Stockholm, Tokio, Budapest, Copenhagen, Petrograd. Alfred H. Schutte, Cologne, Brussels, Liege, Paris, Milan, Bilbao, Barcelona.



Those Forgings—

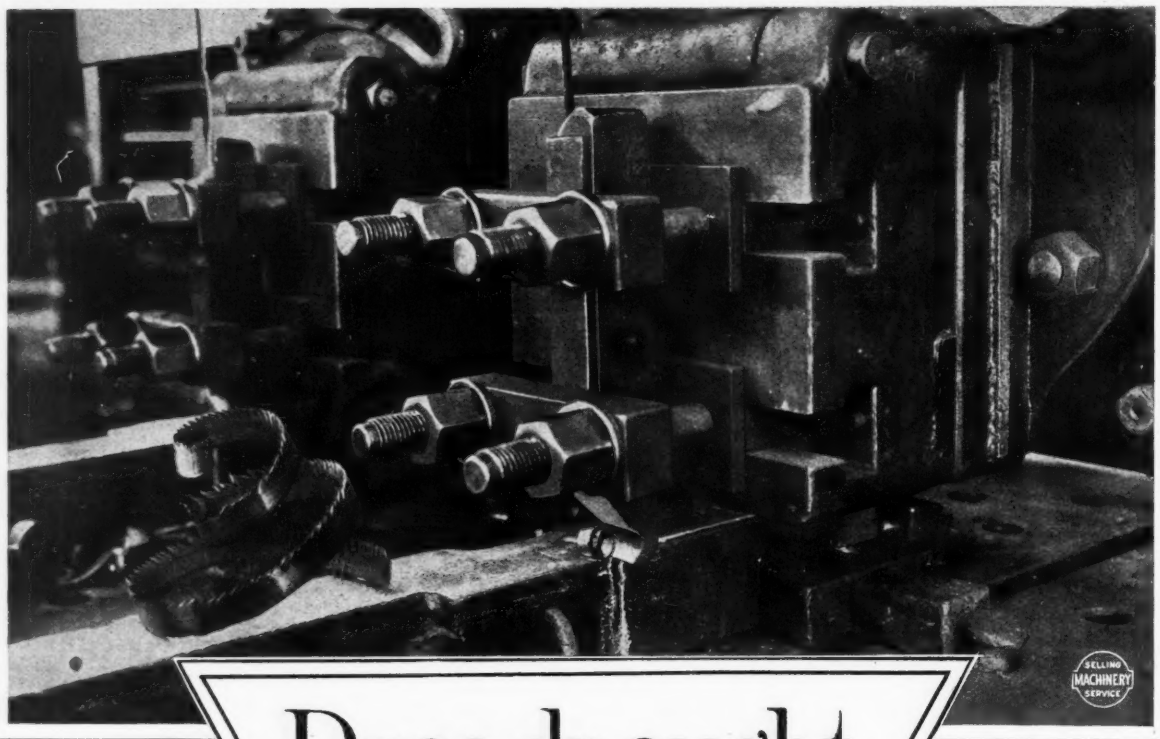
We have the plant, the men, machinery and experience to satisfactorily handle your next order for machinery forgings, no matter what the quantity or material you desire. Forgings of alloy, tool, open hearth or any steel from 18 to 80 point carbon—any size, any shape, any style.

Ask for estimates

The Johnston & Jennings Co.

Addison Road and Lake Shore R. R. Tracks — Cleveland, Ohio

"DREADNOUGHT"



Dreadnought Steel Planer Tools Give Excellent Service

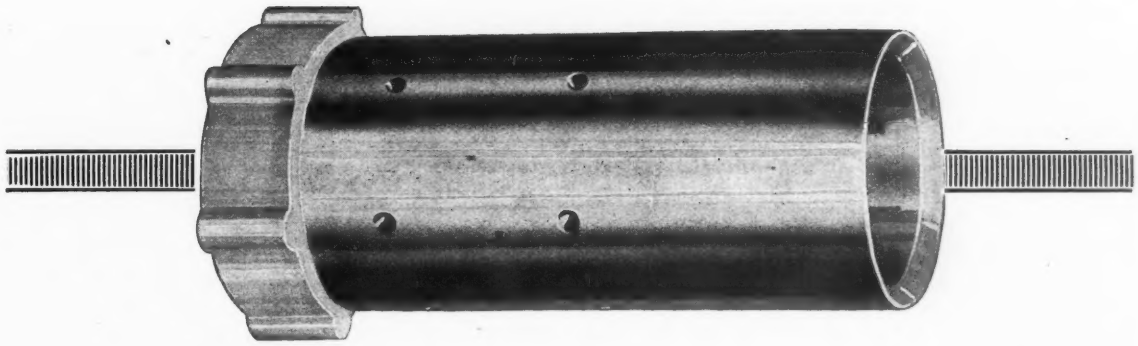
This "Dreadnought" planer tool has just been started on a finishing cut across a large cast-steel frame—the chips shown having been made by a roughing tool which had just been removed. These large chips indicate the quantities of metal a "Dreadnought" tool can remove; they are as blue as indigo, which gives some idea of the speed at which the machine was operated. In this plant, a large locomotive shop in Pennsylvania, the only high-speed cutting steel used is "Dreadnought." Many other steels have been tried; but the best results have always been accomplished by "Dreadnought."

"Dreadnought" is surpassed by no steel, domestic or foreign, where severe duty is required. For heavy lathe, planer and boring tools, roughing tools, forming tools, alloy steel gear cutters, flat and twisted drills, etc., you'll find it gives excellent service, always. Dreadnought High Speed Steel does not require "fussy" heat treatments, and therein lies one of its great advantages—we'll tell you more about this feature if you'll ask. Ask also for the complete Halcomb catalogue listing Dreadnought, Ketos, Halcomb Chrome Vanadium, "L.C.T." Alloy and other steels.

HALCOMB STEEL COMPANY

SYRACUSE NEW YORK

BRANCHES: CHICAGO PHILADELPHIA CLEVELAND BOSTON NEW YORK



The Price you Pay for Bunting's Bronze Bushings and Bearings (Patented) does not include the Cost of Patterns or Material Lost through Defective Workmanship

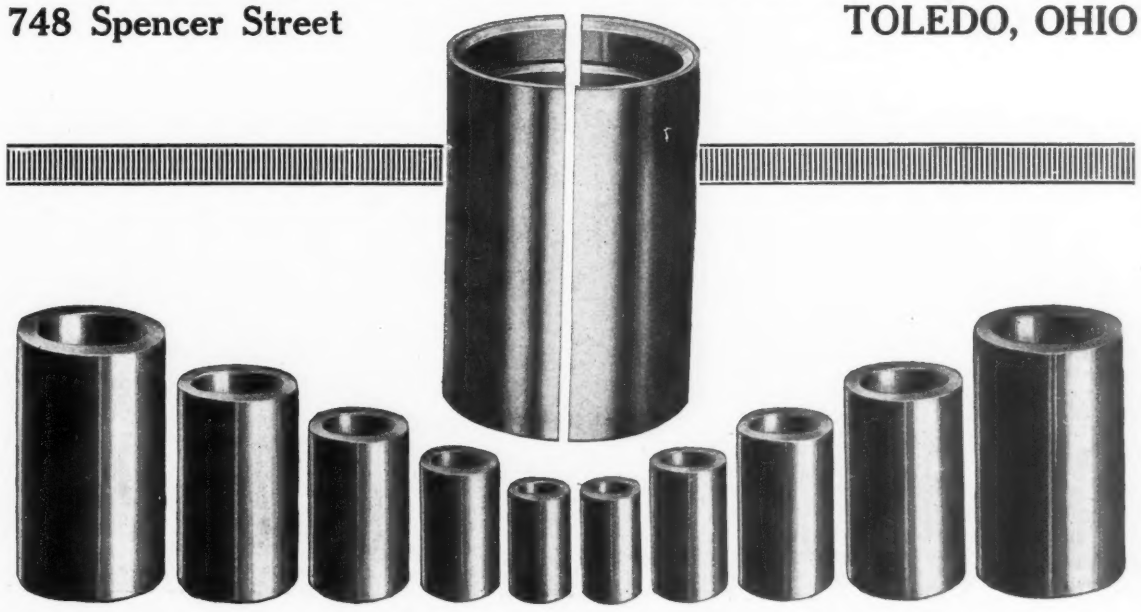
The practice of making your own bushings and bearings is expensive when you consider the cost of patterns, the waste of material through defective castings, the chances of inaccurate results and the amount of skilled labor necessary to produce the bushing or bearing you want.

You can buy Bunting's (Patented) Bronze Bushings and Bearings *already machined to size and shape.* You can save money by using them—for you pay only for what you get—no patterns, no defective castings, no defective labor. You buy bearings or bushings ready to assemble—and save from 10 per cent to 100 per cent over the cost of the castings and machine work.

Ask us to show what we can save for YOU—on the bushings or bearings YOU use.

THE BUNTING BRASS & BRONZE COMPANY

748 Spencer Street **TOLEDO, OHIO**



BLUE CHIP

AND OTHER

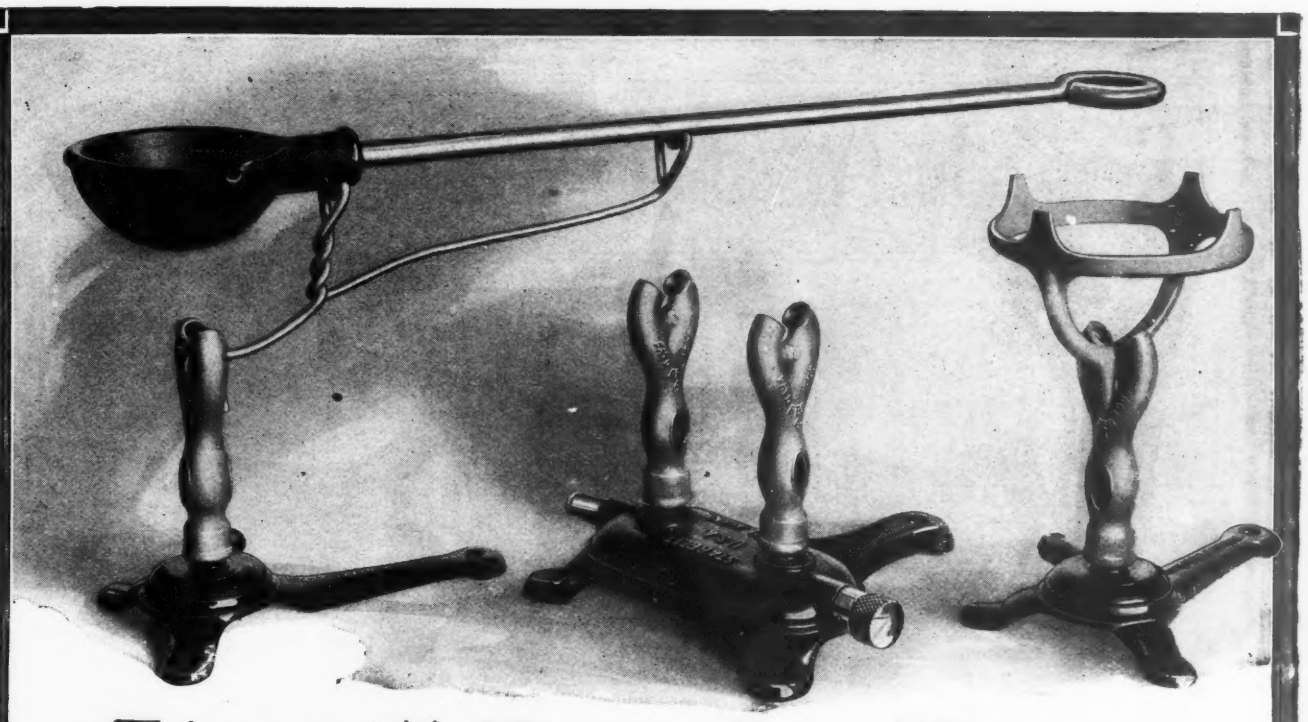
Firth-Sterling Tool Steels

THE knowledge, experience and skill of Sheffield combined with the best Pittsburgh practice have made these steels the standards of Quality and Uniformity wherever Tools are used.

FIRTH-STERLING STEEL COMPANY

McKEESPORT, PA.

BOSTON NEW YORK PHILADELPHIA CHICAGO
CLEVELAND PITTSBURGH DETROIT



Starrett Twin Gas Heater

TRADE MARK
REG. U.S. PAT. OFF.

THIS HEATER is very efficient in the machine shop, especially in the tool-room, for tempering small tools, melting lead, babbitt, etc., and as a forge for light work. You will also find this heater extremely handy, useful and economical in your home. For laboratory work and wherever a blue-flame burner is required the Starrett Twin Gas Heater has no equal.

Its effectiveness lies in its scientific construction. The gas and air is thoroughly mixed for perfect combustion while passing through the deflectors in base of tubes. The tubes cause the flames to penetrate each other at cross-angles, thus producing an intense heat, free from smoke and with no waste of gas.

RETAIL PRICES

No. 100A	Burner only, without base	$0.75
No. 100B	One Burner with base	1.00
No. 100C	Two Burners with base	2.00
No. 100D	Three Burners with base	3.00
No. 100E	Tool Holder only .	.15
No. 100F	Dish Holder . .	.25
No. 100G	Ladle only . .	.25
No. 100H	One Burner with Base, Tool Holder and Dish Holder . . .	1.40

For sale at leading Hardware Stores
Send for Free Starrett Catalog No. 21-D

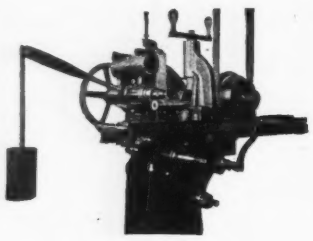
STARRETT TOOLS TRADE MARK REG. U.S. PAT. OFF.

The L. S. Starrett Co., Athol, Mass.

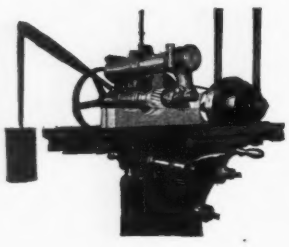
"The World's Greatest Tool Makers"

London New York Chicago

Here's Just What You Need in Your Shop



Keyseating



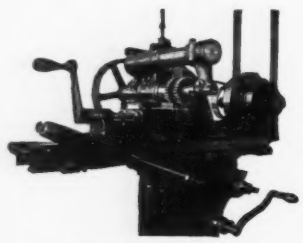
Profiling

FOREIGN AGENTS:

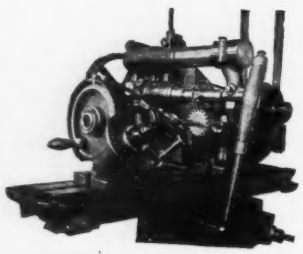
C. W. Burton, Griffiths & Co.
London, England

Fenwick Freres & Co.
Paris, France

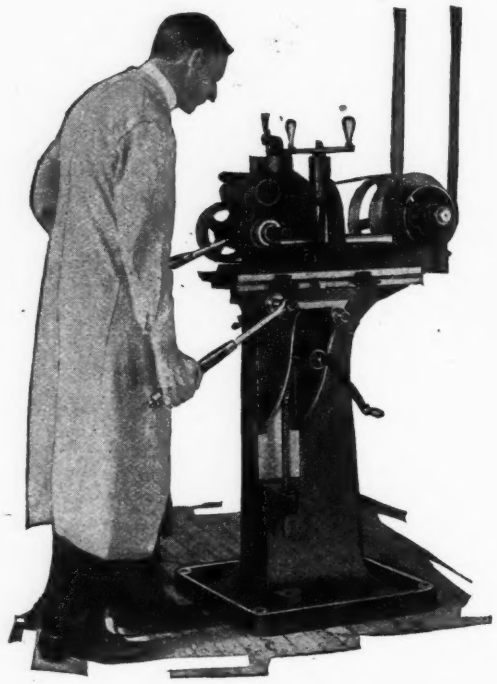
F. G. Kretschmer & Co.
Frankfurt a/M.
Germany



Straddle Milling



Sprocket or Gear Cutting



Because it is an all-around machine with a wide range of work—capable of taking both light and heavy cuts. It is so well built that it can be used to great advantage in place of larger tools costing twice the money.

It will handle all of your small milling jobs and earn its cost in a short time because there is work constantly turning up that can be done on this machine.

The "Whitney" Hand Milling Machine

has features which make it a necessary tool for every shop and tool room, such as its High-Speed Milling Attachment. This attachment permits the use of end mills for die sinking, profiling, drilling and all classes of light milling where small cutters and high speeds are necessary.

The Jones & Lamson Machine Co., Springfield, Vt., say: "Your milling machine is one of the most indispensable tools in our milling department on account of its adaptability to many uses."

Simply drop a postal for details

THE WHITNEY MFG. CO.

HARTFORD CONN., U.S.A.

CHAINS—KEYS—HAND MILLING MACHINES

Over-Shadowing Supremacy
SHELBY
SEAMLESS STEEL TUBING
ADAPTED FOR A VARIETY OF USES IN MECHANICAL AND ENGINEERING LINES
SEND FOR ILLUSTRATED BOOKLET ON SEAMLESS TUBES
NATIONAL TUBE COMPANY
The GRAND PRIZE
MEDAL OF HONOR
GOLD MEDAL
SILVER MEDAL
BRONZE MEDAL
"SHELBY" Seamless Steel Tubing was awarded the Grand Prize at the Panama-Pacific International Exposition, San Francisco, Cal., 1915. Only one GRAND PRIZE was awarded to each class of products exhibited. While there were Medals of Honor, Gold, Silver or Bronze, given to each separate class of materials, there was only one GRAND PRIZE, and that was awarded to "SHELBY" Seamless Steel Tubing, "as representing the highest development of the art."
Write today for a copy of "NATIONAL" Bulletin Number 17
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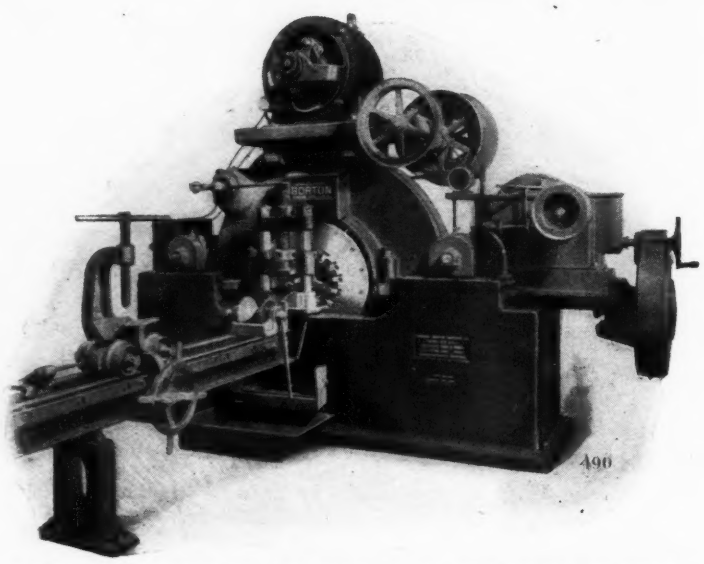
NATIONAL TUBE COMPANY
General Sales Offices: PITTSBURGH, PA.
"* * * * The Summit Crowns the Height The Lesser Peaks Adorn."

Immediate Delivery

On One Machine as Below from Stock—And One Per Week

Cost of Production and Repairs Considered, this is the cheapest tool there is



FRONT VIEW GORTON NO. 2-B HEAVY DUTY CUTTING-OFF MACHINE—Capacity 6 inch Rounds or Less; 5-inch Squares or Less. Photo shows Standard Equipment 20 H.P. 2.1 Variable Speed Motor, as motor is preferably connected with 6" endless belt with provision for taking out slack. Any make motor may be quickly installed by the purchaser.

Net Weight Complete with Power Stock Clamp but without motor, 21,000 pounds. Code Word (Complete as shown but without motor) Kroudslager.
(Special Catalog on request.)

No. 2-B Gorton Heavy Duty Cutting-Off Machine

DECIDEDLY, this is the only machine for shrapnel and shell work. Cost of production and repairs considered, this is the cheapest tool of its kind there is. It is built by a firm which has as its head one of the most capable machine and tool designers in the country. The product of this shop has an enviable record during the past decade for actual performances and economy of operation. The very appearance of each machine shows its inherent strength.

First cost is lost in the record of this machine's output. Compared with any other method this machine has actually paid for itself seven or eight times during an 18-month contract.

This one of a battery of four machines in the Allis-Chalmers Mfg. Co.'s plant at Milwaukee, Wis., is cutting 3—3¼-in. bars 30 ft. long of **finished shell steel** into shell billets all day long. Minimum production 50 billets per hour for each machine. It is freely admitted by those "who know," the company couldn't get out their contract without using these machines.

In Canada at the Dominion Iron & Steel Co.'s plant at Montreal, a battery of seven of these machines are producing every 22 working hours (two shifts) between 8,000 and 9,000 billets of **finished shell steel.** To show graphically the difference between cutting finished shell steel and ordinary open-hearth steel this same battery would cut 15,000 billets per day.

Approximate cost per 100 blanks, $1.60 to $1.65. Mark you, this includes all labor cost of handling the bars, placing in machines, cutting off, removing burrs, marking and loading onto cars. In other words, $1.60 to $1.65 represents the actual cost from bar to car. Each machine in the Allis-Chalmers plant has an air pusher that automatically feeds the 30-ft. bar to the cutter. This reduces labor cost.

A Gorton Cutting-Off Machine will prolong the life of the High-Speed Tool Steel Cutters because the design of the machine is such that there is positively no vibration, and even where operating at full speed, absolutely no chattering. The blade will not shake or deflect a hair's breadth from its true position.

When cutting 6½-in. round finished shell steel the production is 550 per 22 hours' work, while the same machine on ordinary open-hearth steel would double the output—1100 billets.

Prompt—6½ rounds or less machines, one each week—13-in. machines, one every 30 days. These machines will operate successfully 24 hours, day in and day out, and yet keep out of the repair shop. Send for illustrated descriptive catalogue—FREE for the asking—no obligation incurred.

Manufacturers Engraving Machines and Fine Machine Tools of all kinds. Large stock standard size H.S. Steel Cutters always on hand.

Geo. Gorton Machine Co.

Racine, Wisconsin, U.S.A.

CABLE ADDRESS—GORTON—RACINE.

Use A. B. C. Code (4th Edition) or Western Union Code (Universal Edition). Prompt attention given all inquiries.

W
WESTINGHOUSE ELECTRIC

An Extraordinary Motor Installation

The above picture shows a modern plant where Westinghouse Type SK Motors and Type C Automatic Control play a leading part in securing this ideal plant arrangement.

259 Westinghouse Type SK Motors

are installed driving machine tools. A total absence of belts speaks for individual motor drive—increased production; no transmission losses; less power cost; no delays due to lineshaft failure; better work, due to cleaner and brighter plant conditions—all these are reasons why you should specify Westinghouse Type SK Motors for your machine tools.

Westinghouse Type C Automatic Controllers

are mounted on headstock of the lathes. The control is within easy reach of the operator. All movements of the lathe are under his complete control. A push button starts and stops the motor. Westinghouse Type C Automatic Control is simple, reliable and easy to operate, and, together with Westinghouse Type SK Motors, makes a winning combination.

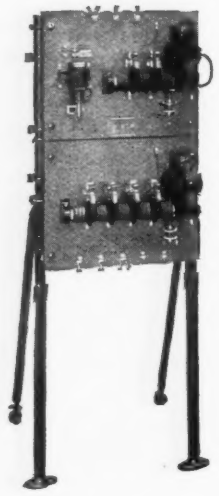
388

Westinghouse Electric & Manufacturing Co.

East Pittsburgh, Pa.

Send for Book 3042, containing the story of Motor-Driven Machine Tools.

Westinghouse



Which Meets Your Requirements?

Moisture Resisting
Moisture Proof
Weather Proof
Splash Proof
Acid Proof
Dust Proof
Gas Proof
Explosion Proof
for Powder Mills, etc.

G-E Control Resists Moisture

A G-E Automatic Compensator controls a motor-driven pump at the East Deerfield pumping plant of the Boston & Maine R. R.

During a recent flood this outfit ran under water for an hour before the switch was opened.

The panel and motor were under water a total of approximately five hours, then they were taken out and baked for about eight hours. The equipment was then put back in service and is now operating satisfactorily.

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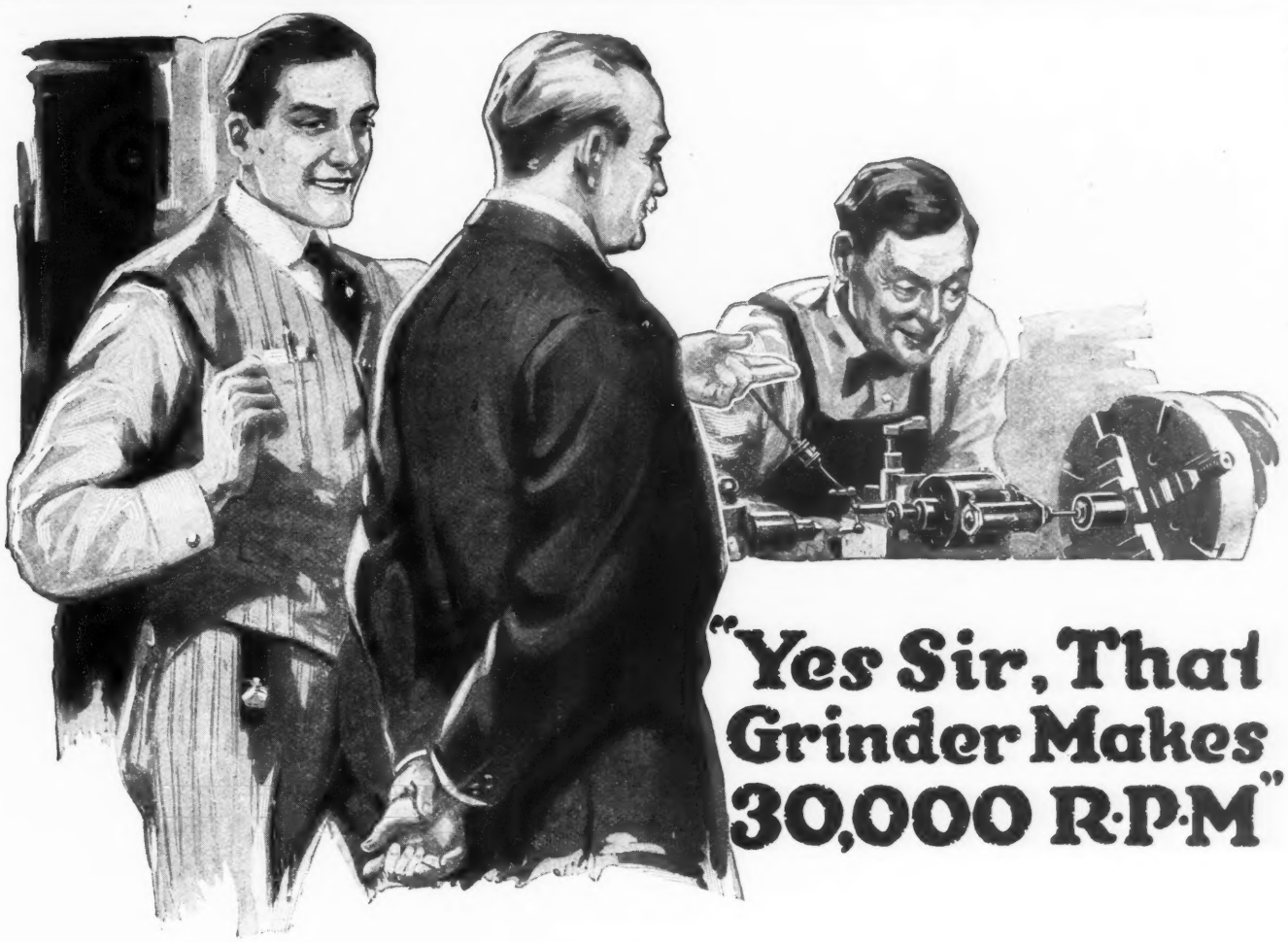

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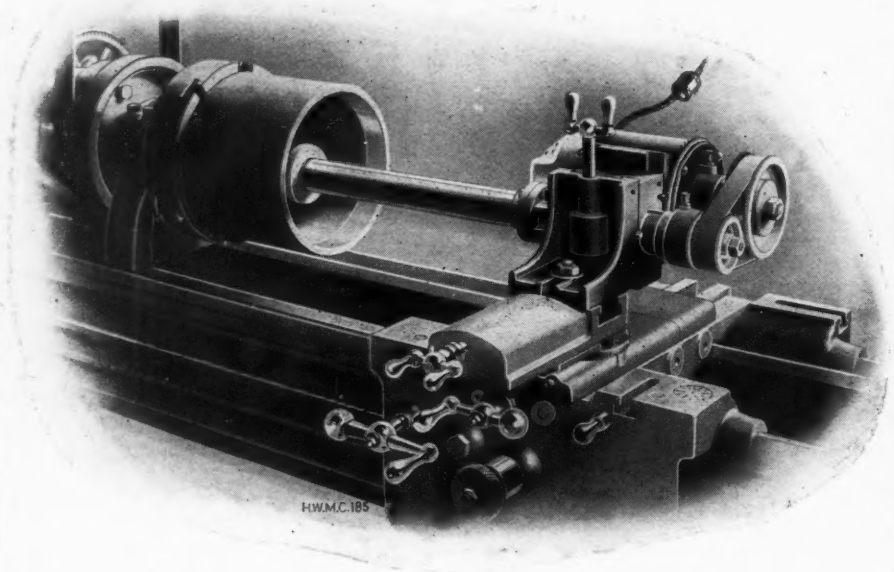

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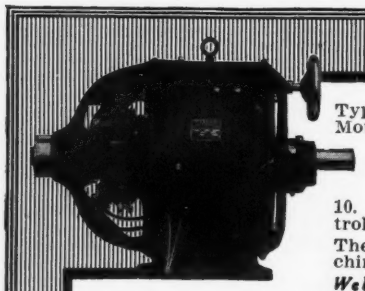

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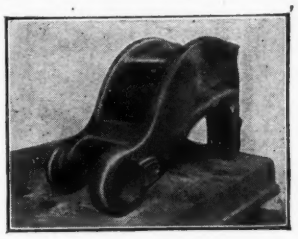

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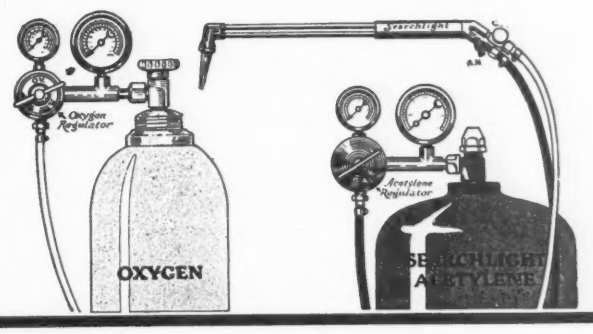

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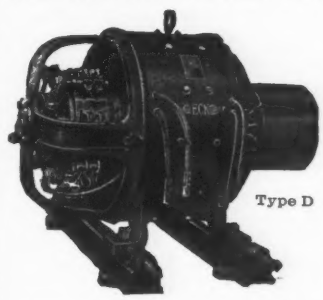

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PUNCHES—DIES—PRESS WORK

Clearance between Punches and Dies. — The amount of clearance between a punch and die for blanking and perforating, or the difference between the size of the punch and die opening, is governed largely by the thickness of the stock to be operated upon. For thin material such as tin, for example, the punch should be a close sliding fit, as, otherwise, the punching will have ragged edges, but for heavier stock there should be some clearance, the amount depending upon the thickness of the material. The clearance between the punch and die when working heavy material lessens the danger of breaking the punch, and reduces the pressure required for the punching operation. To obtain the clearance between the punch and die, divide the thickness of the stock by a number or constant selected according to the following rules which apply to different materials: For soft steel and brass, divide the thickness of the stock by the constant 20; for medium rolled steel, divide by 16; for hard rolled steel, divide by 14.

Example: What would be the clearance between a punch and die to be used for perforating or blanking soft steel 0.050 inch thick?

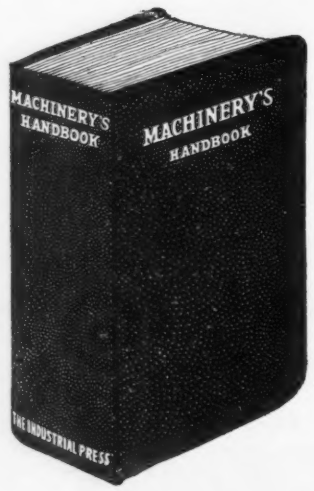
$$\frac{\text{Thickness of stock}}{20} = \frac{0.050}{20} = 0.0025 \text{ inch.}$$

Whether this clearance is deducted from the diameter of the punch or added to the diameter of the die depends upon the nature of the work. If a blank of given

Clearances Between Punches and Dies for Different Materials

Thickness of Stock, Inches	Clearance, Inches			Thickness of Stock, Inches	Clearance, Inches		
	Brass, Soft Steel	Medium Rolled Steel	Hard Rolled Steel		Brass, Soft Steel	Medium Rolled Steel	Hard Rolled Steel
0.010	0.0005	0.0006	0.0007	0.120	0.0065	0.0072	0.0084
0.020	0.0010	0.0012	0.0014	0.140	0.0075	0.0084	0.0098
0.030	0.0015	0.0018	0.0021	0.160	0.0085	0.0096	0.0112
0.040	0.0020	0.0024	0.0028	0.180	0.0095	0.0108	0.0126
0.050	0.0025	0.0030	0.0035	0.200	0.0105	0.0120	0.0140
0.060	0.0030	0.0036	0.0042	0.220	0.0115	0.0132	0.0164
0.070	0.0035	0.0042	0.0049	0.240	0.0125	0.0144	0.0178
0.080	0.0045	0.0048	0.0056	0.260	0.0135	0.0156	0.0192
0.090	0.0050	0.0054	0.0063	0.280	0.0145	0.0168	0.0206
0.100	0.0055	0.0060	0.0070	0.300	0.0155	0.0178	0.0220

size is required, the die is made to that size and the punch is made smaller. Inversely, when holes of a given size are required, the punch is made to correspond with the diameter wanted and the die is made larger. Therefore, for blanking to a given size, the clearance is deducted from the diameter of the punch, and for perforating, the clearance is added to the diameter of the die. To illustrate, suppose we want to blank hard rolled steel having a thickness of 0.0625 inch (No. 16 gage) to a diameter of 1 inch. What would be the sizes for the punch and die? The clearance equals $\frac{0.0625}{14} = 0.0044$ inch. As this is a blanking operation, the die is made 1 inch, and the punch diameter equals $1 - 0.0044 = 0.9956$ inch.



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Angular Clearance for Dies. — The amount of angular clearance ordinarily given a blanking die varies from one to two degrees, although dies that are to be used for producing a comparatively small number of blanks are sometimes given a clearance angle of four or five degrees to facilitate making the die quickly. When a large number of blanks are required, a clearance of about one degree is used. There are two methods of giving clearance to dies: In one case the clearance extends to the top face of the die; in the other, there is a space about ⅛ inch below the cutting edge which is left practically straight, or having a very small amount of clearance. For very soft metal, such as soft, thin brass, the first method is employed, but for harder material, such as hard brass, steel, etc., it is better to have a very shallow clearance for a short distance below the cutting edge. When a die is made in this way, thousands of blanks can be cut with little variation in their size, as grinding the die face will not enlarge the hole to any appreciable extent.

Lubricants for Press Work. — Dies are often run without lubrication, but they will last longer if oiled slightly. The oil is applied to the stock either from a saturated felt-roller, brush or pad, or by coating one sheet thickly and then feeding it through the rolls. By the latter method, the rolls are coated with sufficient lubricant for a number of sheets, and a very thin coat is applied to the material so that the work does not have to be cleaned, as is sometimes necessary when a felt-roller or pad is used. Lard or sperm oil is used when punching iron, steel or copper. For drawing steel, the following mixture is recommended: 25 per cent flaked graphite; 25 per cent beef tallow; and 50 per cent lard oil. This mixture should be heated and the work dipped into it. Oildag mixed with heavy grease is also used for steel, and a thin mixture of grease (preferably tallow) and white lead has proved satisfactory. The following compound is also used for drawing sheet steel of a mild grade: Mix one pound of white lead, one quart of fish oil, three ounces of black lead, and one pint of water. These ingredients should be boiled until thoroughly mixed. For working brass or copper, a solution composed of 15 pounds of Fuller's soap to a barrel of hot water (used hot), or any soap strong in rosin or potash, is cheaper and cleaner than oil. The stock should pass through a tank filled with this solution before entering the dies. For cutting aluminum, use kerosene, and for drawing aluminum, use vaseline of a cheap grade. Lard oil is also applied to aluminum when drawing deep shells. Aluminum should never be worked without a lubricant. For many classes of die work, no lubricant is required, especially when the metal is of a "greasy" nature, like tin plate, for instance.

Annealing Drawn Shells. — When drawing steel, iron, brass or copper, annealing is necessary after two or three draws have been made, as the metal is hardened by the drawing process. For steel and brass, anneal between every other reduction, at least. Tin plate or stock that cannot be annealed without spoiling the finish must ordinarily be drawn to size in one or two operations. Aluminum can be drawn deeper and with less annealing than the other commercial metals, provided the proper grade is used. In case it is necessary to anneal aluminum, this can be done by heating it in a muffle furnace, care being taken to see that the temperature does not exceed 700 degrees F.

Drawing Brass. — When drawing brass shells or cup-shaped articles, it is usually possible to make the depth of the first draw equal to the diameter of the shell. By heating brass to a temperature just below what would show a dull red in a dark room, it is possible to draw difficult shapes, otherwise almost impossible, and to get shapes with square corners.

Drawing Rectangular Shapes. — When square or rectangular shapes are to be drawn, the radius of the corners should be as large as possible, because it is in the

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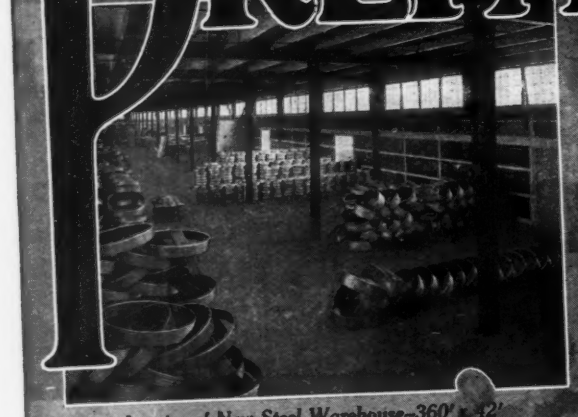

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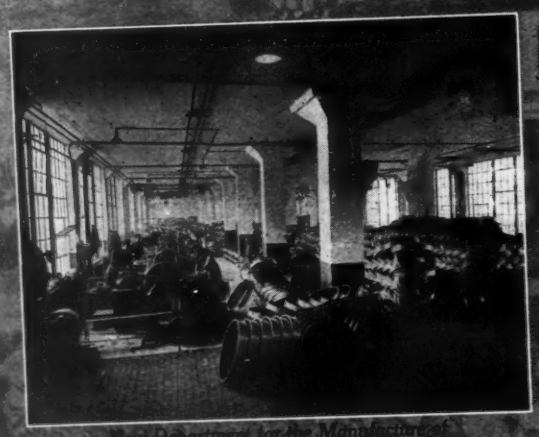

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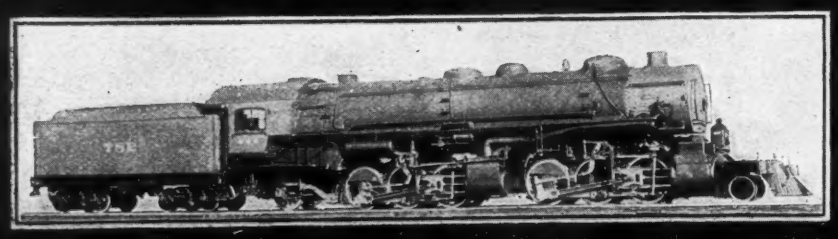
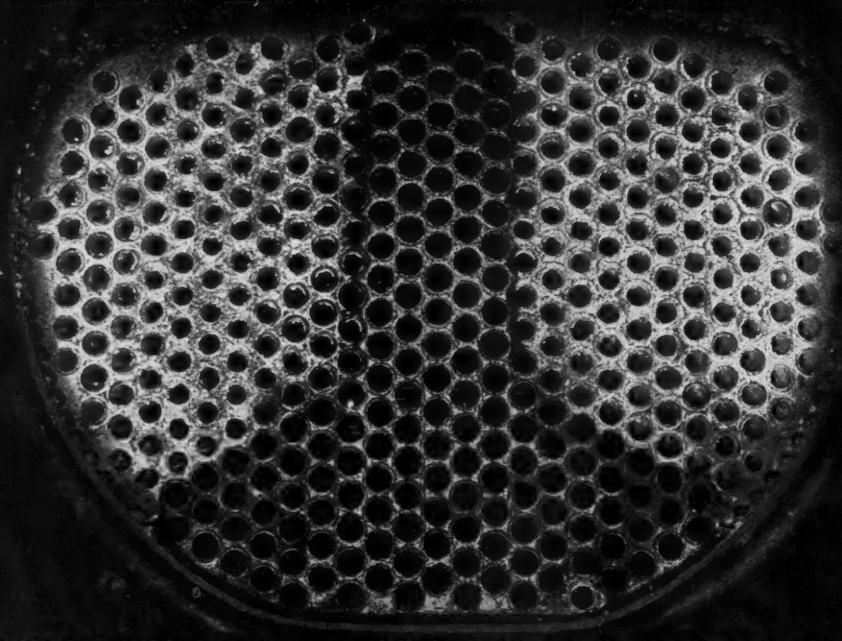


Carbon electrode used for cutting or heavy current welding



Metal electrode builds up or fills cavities when welding

Light portions show welded tube ends in locomotive

BENEATH the C & O locomotive illustrated above, which has welded seams and flue sheets, is shown a partly completed locomotive flue sheet. The light portions show flue ends which have been welded by a G-E arc welding outfit, one type of which, used by the American Locomotive Company, is shown at the bottom of this page.

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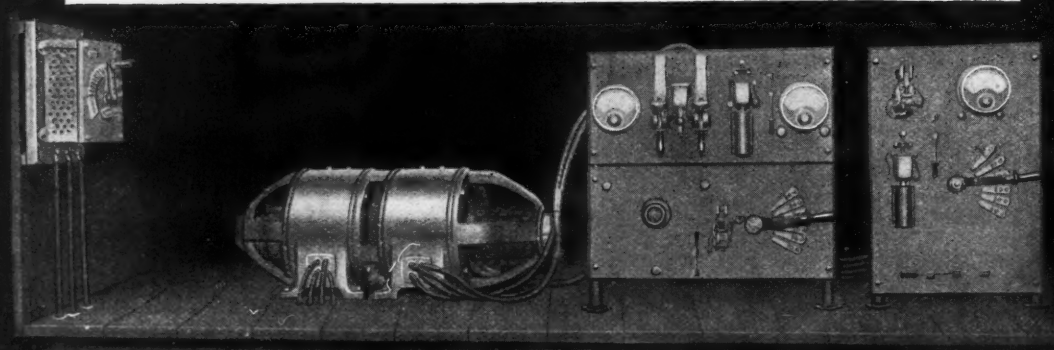

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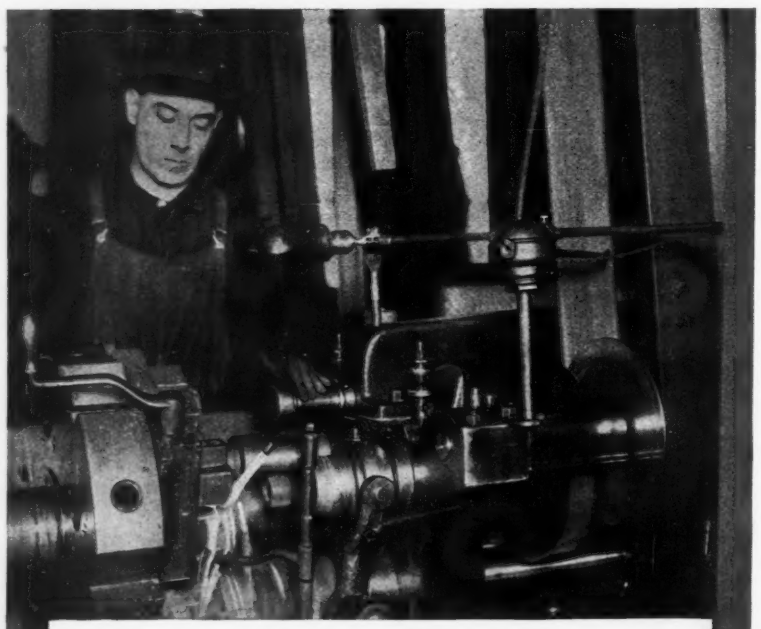


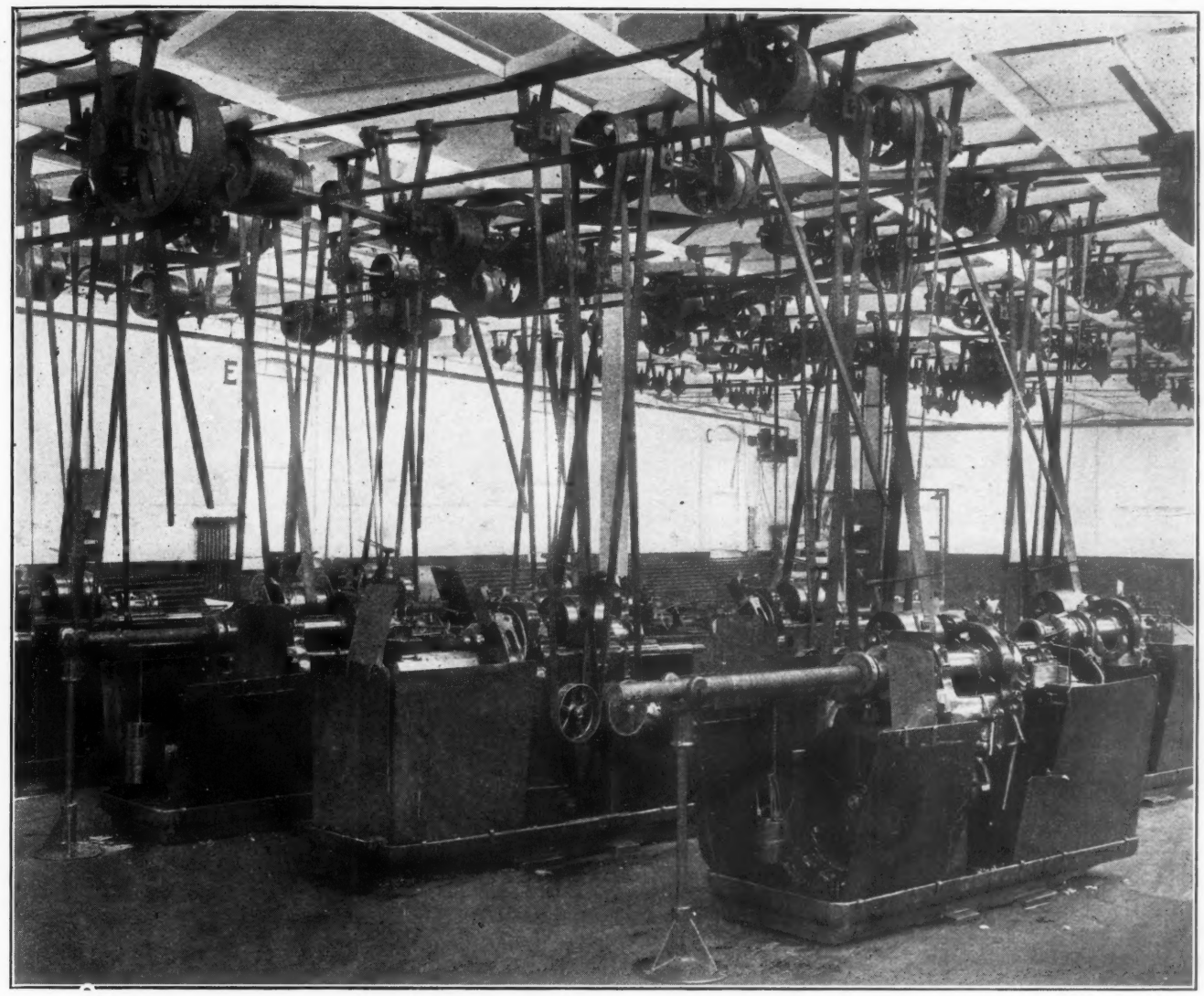
It's "Cataract 501" that Makes it Possible

THIS automatic chucking machine is one of a battery of eight that runs twenty-four hours a day machining hot-forged brass parts, one of the toughest brass turning jobs in the shop. In spite of its being difficult work, production is high, and, what is still better, it is secured at the minimum cost for tools. "Cataract 501" is the reason. From the day "Cataract 501" was put in service as the cutting lubricant, production increased and tools made fewer trips to the grinding wheel. Try it out in your shop on hard jobs, long runs and high speeds.

We will furnish sample free if you will tell us where to send it.

CATARACT REFINING & MANUFACTURING CO.

General Offices: BUFFALO
Plants: BUFFALO and CHICAGO



A Battery of Gridley Automatics

Countershafts and Loose Pulleys run on

Gurney Ball Bearings

Shut-downs because of counter-shaft or loose pulley troubles are absolutely unknown.

CAPACITY GURNEY ENDURANCE

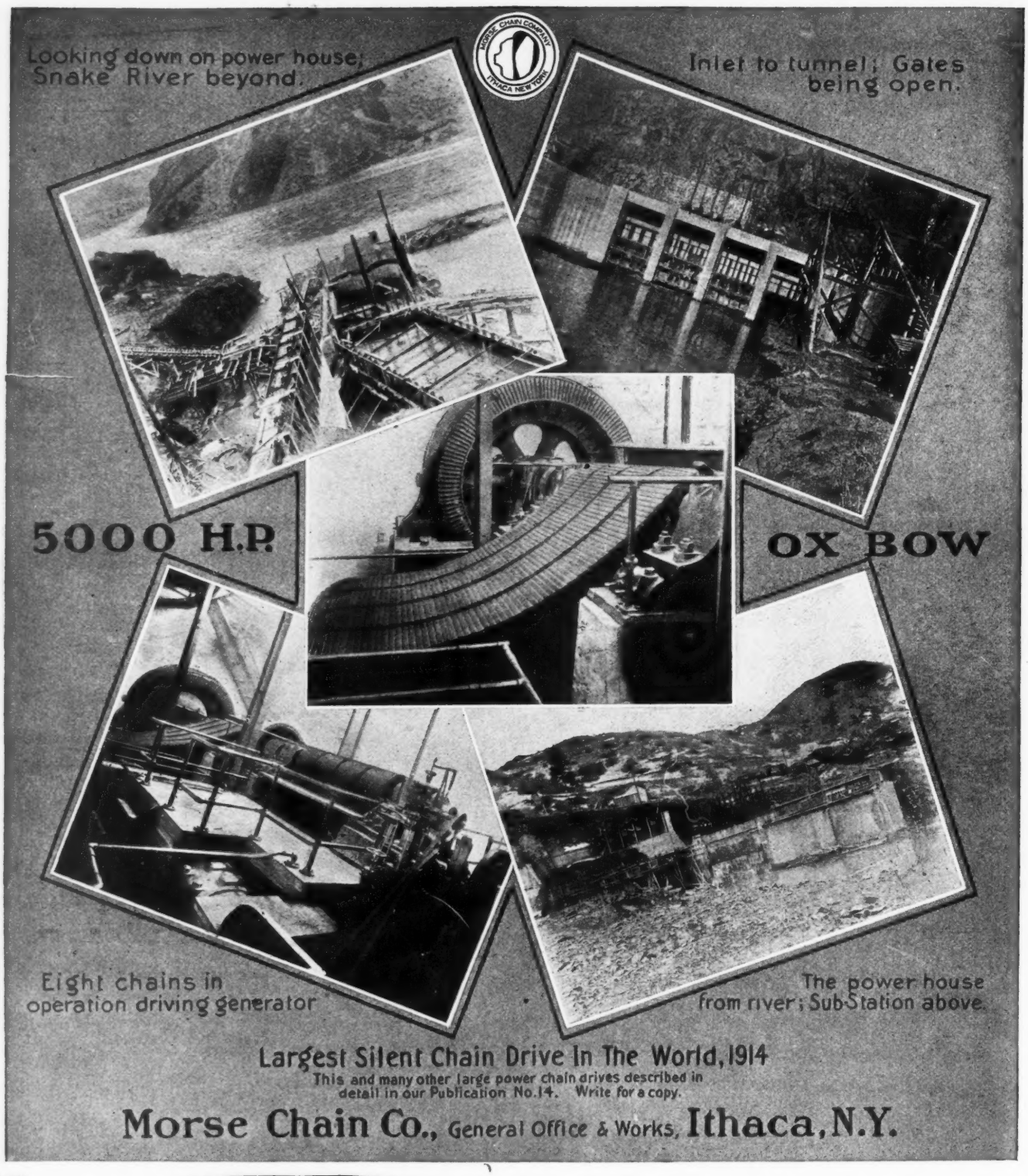
GURNEY BALL BEARING CO.

Conrad Patent Licensee

JAMESTOWN, NEW YORK

Chicago, Ill. New York City

CAPACITY GURNEY ENDURANCE


Looking down on power house; Snake River beyond.
Inlet to tunnel; Gates being open.
5000 H.P.
OX BOW
Eight chains in operation driving generator
The power house from river; Sub-Station above.

Largest Silent Chain Drive In The World, 1914

This and many other large power chain drives described in detail in our Publication No. 14. Write for a copy.

Morse Chain Co., General Office & Works, **Ithaca, N.Y.**

191,520 steel links of this size were required for the eight chains composing the above drive.

Each chain is 21" wide by 31.67' long. The eight chains cover an area 14 by 31.67 feet, or 21" by 253.36 feet.

Total weight of eight chains, assembled, 21282 pounds, of eight double sprockets 43200 pounds.

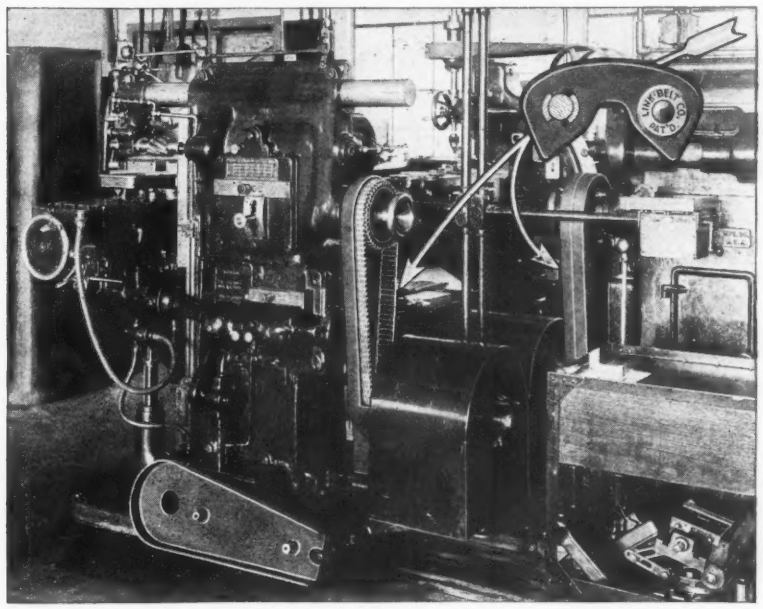
Other information furnished on request.

MORSE CHAIN CO., ITHACA, N. Y

Too Long and Too Short

Here is a milling machine drive, the center-to-center distance of which is too long for a practicable gear drive, yet too short for a belt transmission. It is a typical drive for Link-Belt Silent Chain—the transmission that is equally good on long or short centers.

Flexible as a Belt. Positive as a Gear.
More efficient than either.



Link-Belt Silent Chains Driving Brown & Sharpe Milling Machines, Plant of Western Electric Co., Chicago.

Link-Belt Silent Chain

in machine shop duty doesn't stop at convenience of application. It is efficient (98.2 per cent on actual test), so positive that it will pull anything that motor and machine can carry. It cannot slip.

Look for the name on the washers; look for the liners in the joints.

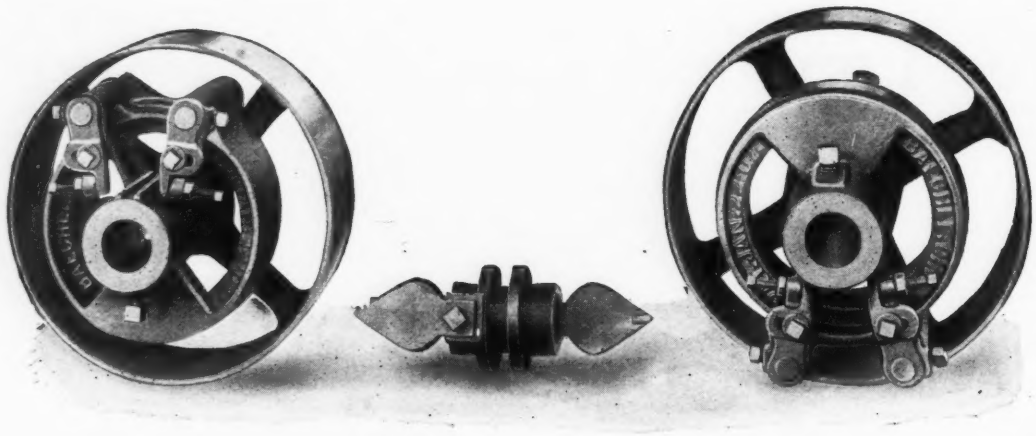
The success of Link-Belt Silent Chain is due to its patented Pin-Bushed-Joint construction—a round pin and two case-hardened semi-circular bushings—found in no other chain.

Write for Data Book No. 125 which shows how to figure machine tool drives and determine prices.

LINK-BELT COMPANY

PHILADELPHIA CHICAGO INDIANAPOLIS

New York.....299 Broadway
Boston .....49 Federal St.
Pittsburgh.....1501 Park Bldg.
St. Louis.....Central Nat'l Bank Bldg.
Buffalo .....698 Ellicott Square
Cleveland .....1301 Rockefeller Bldg.
Detroit.....732 Dime Bank Bldg.
Wilkes-Barre .....2nd Nat'l Bank Bldg.
Minneapolis .....418 So. Third St.
Louisville, Ky., Frederick Wehle, Starks Bldg.
Seattle .....580 First Ave., S.
Portland, Ore. .....14th & Lovejoy Sts.
Los Angeles.....161 N. Los Angeles St.
Denver, Lindrooth, Shubart & Co., Boston Bldg.
San Francisco, Meese & Gottfried Co., 400 E. Third St.
New Orleans, Whitney Supply Co., 418 So. Peters St.
Knoxville, Tenn..D. T. Blakey, Empire Bldg.
Charlotte, N. C., J. S. Cothran, Coml. Bk. Bldg.
Toronto.....Canadian Link-Belt Co., Ltd.



Pulleys Shafting
Hangers Couplings
Collars Belting
Complete Countershafts

Send for catalog giving further details and prices.

Full Uniform Bearing on Pulley

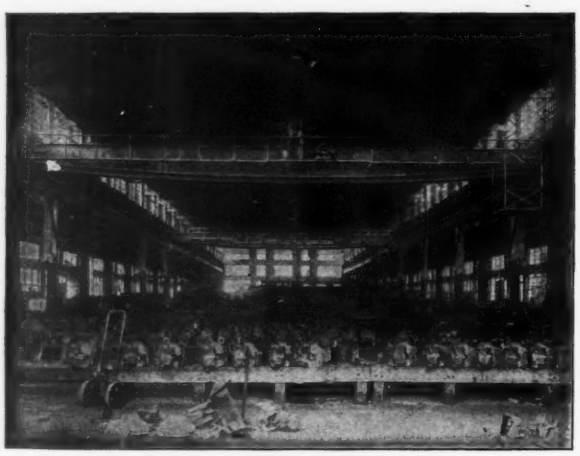
An enormous gripping power exerted by an expanding floating ring—means exceptional efficiency.

Standard Countershaft Clutch

BAECHLE PATENT

A clutch, simple in construction and simple in operation with very high capacity of power transmission. Adjustment is extremely simple—the mere loosening or tightening of a set screw does the work.

STANDARD PULLEY COMPANY, Cincinnati, Ohio

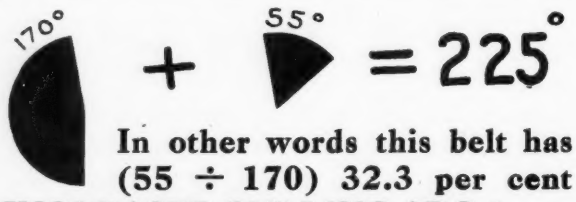


CRANES For All Purposes

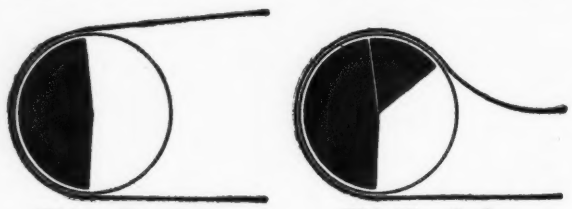
ELECTRIC AND HAND POWER

Case Standard Cranes are the result of thoroughly tested ideas secured during many years from the best designing and operating engineers. They are manufactured under the most favorable conditions in a plant recently equipped at large expense for this particular purpose. They represent the greatest value for price charged.

The Case Crane & Engineering Co.
COLUMBUS, OHIO



In other words this belt has (55 ÷ 170) 32.3 per cent INCREASED PULLING ARC due to CLING-SURFACE TREATMENT



Without Cling-Surface *With Cling-Surface*

These diagrams illustrate nicely how Cling-Surface first stops slip. This permits the belt to be run slack without the necessity for tightening. Hence the greatly increased arc of belt contact as shown above.

Cling-Surface-treated belts become impervious to moisture and steam and are not dried out by heat.

The application is very simple and the cost only a few cents per belt per year.

CLING-SURFACE CO
1018 Niagara Street Buffalo N Y

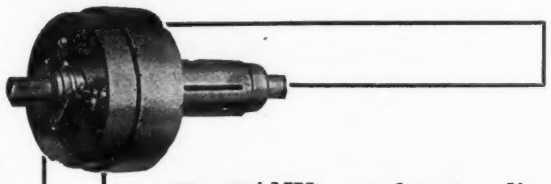
New York Chicago Denver Boston
Memphis St Louis Atlanta
Toronto Etc

London—Thomas & Bishop 119-125 Finsbury Pavement E C

Paris—74 Rue des Ecluses St Martin

Dusseldorf—Stromstrasse 1

92

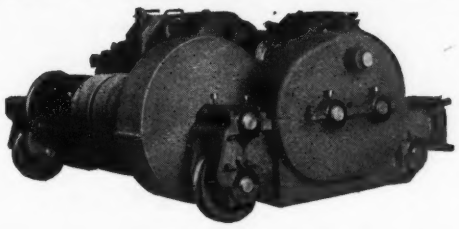


MANY employees dislike to shift belts. The result is considerable power wasted through running idle shafting. Put Moore & White Friction Clutches on those machines and each operator has individual control of his machine; he can *stop it instantly in the event of accident,* machines can be operated in groups and a saving in the cost of belting and shafting can be effected.

The correctness of Moore & White design and the thoroughness of Moore & White construction have been demonstrated by years of service. *Our Circular "M" will give all details.*

The Moore & White Co.
Philadelphia, U. S. A.

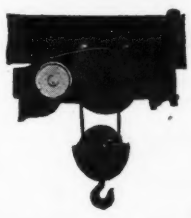
NORTHERN CRANES



Has your crane a modern ship-shape safety trolley like this? This is our

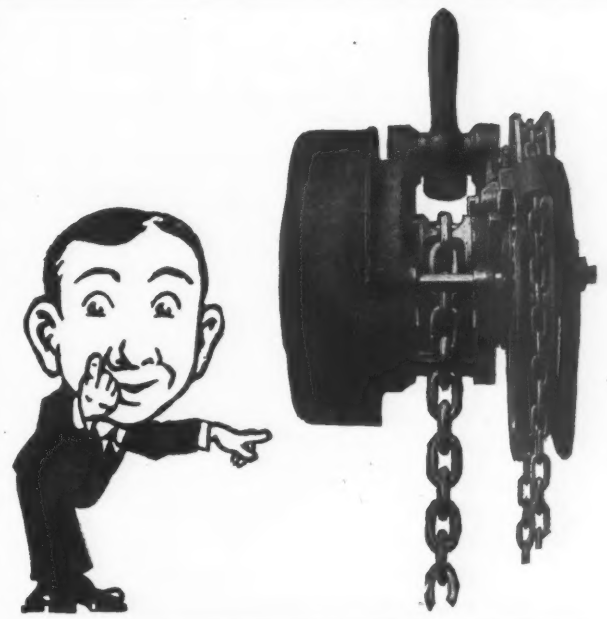
"Type E" Crane Trolley

Made along up-to-the-present lines with all features of safety and efficiency demanded by good engineering practice. Learn more—get our catalogs. We also make



ELECTRIC HOISTS
Air Hoists, Foundry Equipment, etc.

Northern Engineering Works
6 Chene Street **Detroit, Mich.**



Yes, That's the Hoist

that the big railroads and machine shops are buying. Meeting the demand is keeping us hustling every day, and nights too, sometimes. It's the

FORD TRIBLOC CHAIN HOIST

the hoist with steel parts, planetary gears and the highest kind of efficiency.

It's the Hoist that has the famous Ford Loop Hand Chain Guide that keeps the chain from gagging, enables you to operate it at any angle and at any speed you may wish to.

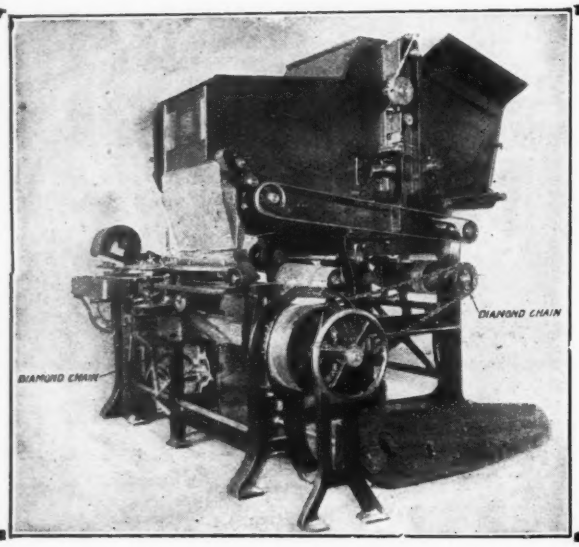
The Loop Hand Chain Guide makes the Ford Tribloc superior in both speed and safety. We back our faith in it with a five years' guarantee.

Catalogue? Surely.
You will be glad to have it and we will be glad to send it.

Ford of Philadelphia

FORD CHAIN BLOCK & MANUFACTURING CO.
137 Oxford Street **PHILADELPHIA, PA.**

Daily Duties of Diamond Chains



Cigarette Making

The rated capacity of this machine is over 250,000 cigarettes daily—about ten each second.

Automatic operation at such a rate of production requires exactness in every function. Every possibility of variation or irregularity must be overcome.

In order to assure positive operation of the tobacco feed and the cutting-off knives, the United Cigarette Machine Co., Ltd., has adopted chain drives in place of belts.

A ½" wide No. 103 Diamond Block Chain replaced a 1" leather belt on the drive for the cutting-off knives. Chain transmits about ⅛ H. P. and operates at a speed of 275 feet per minute over an 18-tooth driving sprocket and a 9-tooth driven sprocket.

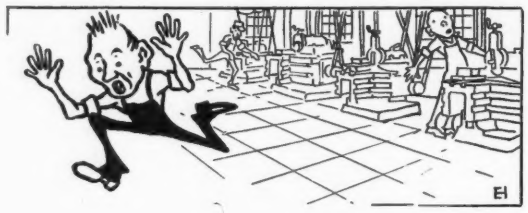
The drive for the automatic tobacco feeder is equipped with a ½" wide No. 155 Diamond Roller Chain operating over a 35-tooth driving sprocket and an 18-tooth driven sprocket. Chain operates at a speed of 525 feet per minute and transmits about 1 H. P., having replaced a 2" leather belt.

Diamond Chain Drives assure positive operation of the mechanism they control, and their neatness and high finish add materially to the appearance of machinery.

Would a chain drive be an improvement on your product?

You should become acquainted with Diamond Chains—the correct Diamond Chain will afford you a better drive. The co-operation of our engineers in the solution of driving problems is a service we offer without obligation.

Diamond Chain & Mfg. Company
240 W. Georgia St. Indianapolis, Ind.



FACTORY laws and the laws of humanity both demand the quick stopping of lineshafting in case of accident. One way to stop it is to run down to the engine room and have the power shut off. A better way is to employ Mule-Pull Friction Cut-off Couplings for this service.

One coupling for each room or department or each lineshaft, any way you wish to make the separation. Then, when anything does occur to require stopping the lineshaft, only the immediate machines are affected by the shut-down.

Let us tell you more about Mule-Pull Friction Couplings and Mule-Pull Clutches. Write us.

Brown Engineering Co.
133 N. Third Street
Reading, Pa.

MULE-PULL CLUTCHES
TRADE MARK

WRIGHT

DURABILITY
AND
SAFETY
the chief assets of
WRIGHT
HIGH SPEED
HOISTS
are made possible by the
STEEL PARTS

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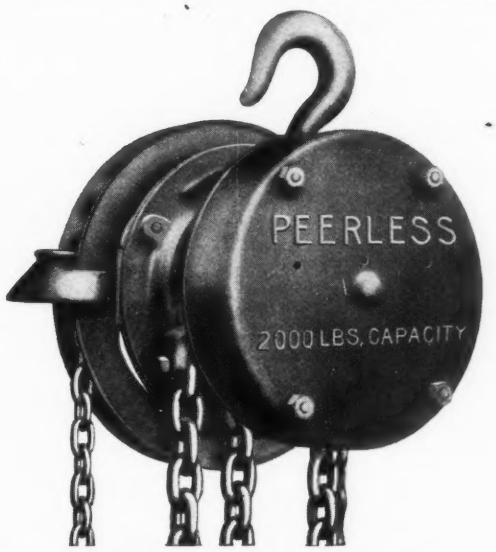
Wright Manufacturing Co.
Lisbon Ohio, U. S. A.

PEERLESS



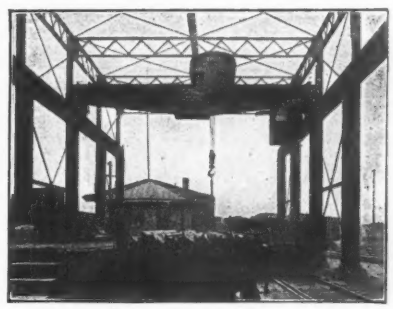
HOISTS

SUPREME IN ENDURANCE

Edwin Harrington, Son & Co., Inc.
Philadelphia, Pa.

For All Parts of Your Plant

For Every Service
Nothing Too Severe
Hand Power or Electric—
D. C. and A. C.



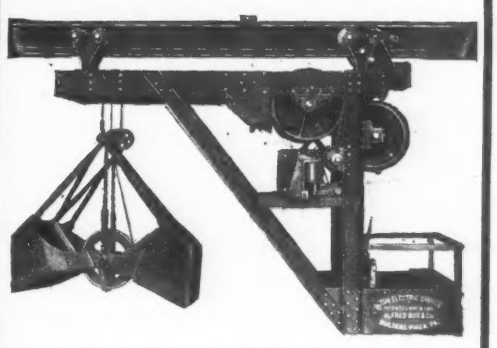
CRANES HOISTS

The Canton Portable Floor Crane

is a one-man tool for lifting-jobs that usually require 4 or 5 men; is easily operated, economical, and strongly constructed. Invaluable in large shops, a necessity in smaller ones. Furnished in a variety of styles and sizes, and specials built for unusual requirements.

Booklet E-10 for more information

THE CANTON FOUNDRY & MACHINE CO.
CANTON, OHIO, U. S. A.



Also
Track Systems and Trolleys

Write for catalogues

Alfred Box & Co.
Philadelphia, Pa.

"TOLEDO CRANES"

FOR EVERY SERVICE

They are quite Reliable

The Toledo Bridge & Crane Co.
2950 Dorr St. TOLEDO, OHIO

SHAW ELECTRIC TRAVELING MONORAIL HOIST

For Factory Transportation—Runs on an Overhead "I" Beam and Occupies No Floor Space
The SHAW "F.T." Monorail is DIFFERENT—The Track-Switch has **No Moving Part.**

Send for Bulletin No. 73

MANNING, MAXWELL & MOORE, Inc., Shaw Electric Crane Co. Dept.

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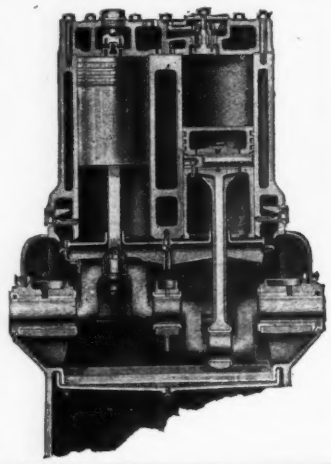
Full Self-Oiling Controlled Splash
Regulatable, Sight Feed Cylinder Oiling

Curtis Compressor

Efficient Cooling, Few Parts
Light Disk Valves, Small Clearances

No stuffing boxes, shoes, slides or guides, less friction and wear, lower maintenance. Will run 10 to 15 times as long with the same amount of oil as competing makes, yet will lubricate all parts properly and keep oil out of the discharge line. Write for descriptive bulletin C-1.



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New Patent **WHIP-HOISTS** and Elevators with Governor Safety
Also Patent Friction Clutches and Pulleys
VOLNEY W. MASON & CO., Inc., Providence, R. I., U.S.A.

Union Steel Rivetless Chains

"The Chain of Double Life"

When the bushings and pins of "Union" Chains finally show wear, reinsert them upside down and start over with a chain as good as new. Samples if desired. Ask for Catalog 3.

THE UNION CHAIN & MFG. CO., Seville, Ohio

Crescent Wood Working Machines

Always satisfy our customers because they are right in both quality and price.

Ask for complete catalog giving description of band saws, jointers, saw tables, planers, shapers, swing cut-off saws, planers and matchers, disk grinders, variety wood workers, universal wood workers, band saw blades.

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A Machinery Finish for Every Need
The Glidden Varnish Company Cleveland Ohio

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Parker White Metal and Machine Co.
ERIE, PENNSYLVANIA, U. S. A.

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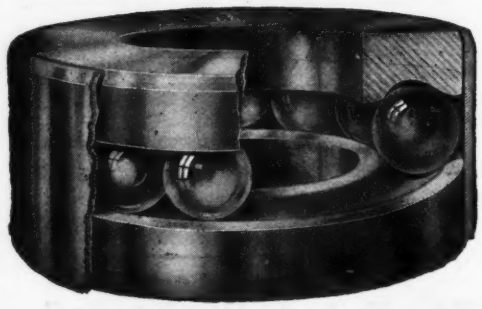
Answer Friction Problems

Steel Balls, Brass and Bronze Valve Balls

State your problem or ask for bulletins



AUBURN BALL BEARING CO., 33 Elizabeth St., Rochester, N.Y.

CULLMAN SPROCKETS

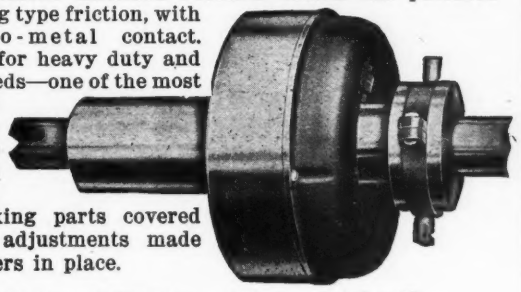
in stock and to order

For Block, Roller and High Speed Silent Chains. New Catalogue.

CULLMAN WHEEL CO., 1339 Altgeld St., CHICAGO

No Safer Clutch than the "Edgemont"

The Edgemont Enclosed Friction Clutch has patented expanding type friction, with metal-to-metal contact. Adapted for heavy duty and high speeds—one of the most powerful hard-service clutches made. All working parts covered and all adjustments made with covers in place.



Full line of Clutches. Ask for Catalog E.

THE EDGEMONT MACHINE COMPANY
2700 National Ave. DAYTON, OHIO

GET OUR OFFICIAL BLUE BOOK

The BANTAM ANTI-FRICTION CO.
BANTAM, CONN.

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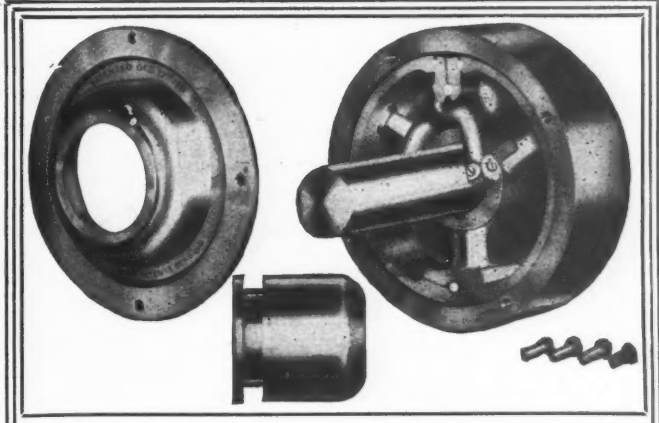

The Cleveland Clutch

is built and designed to give *dependable* and *efficient service*

Our increased manufacturing facilities guarantee prompt *delivery.*

Let us mail you literature.

THE RELIANCE GAUGE COLUMN CO.
6008 Carnegie Ave. CLEVELAND, O.

F. BROWN'S PATENT FRICTION CLUTCH COUPLINGS AND PULLEYS

FOR HIGH SPEED

FRICTION CLUTCH PULLEY

ESTABLISHED 1854
ENGINEERS FOUNDERS
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A. & F. BROWN CO.
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MACHINISTS MILLWRIGHTS

POWER TRANSMISSION MACHINERY
GEARS
FOR MOTOR, MACHINE, MILL OR POWER PLANT
ROPE DRIVES A SPECIALTY

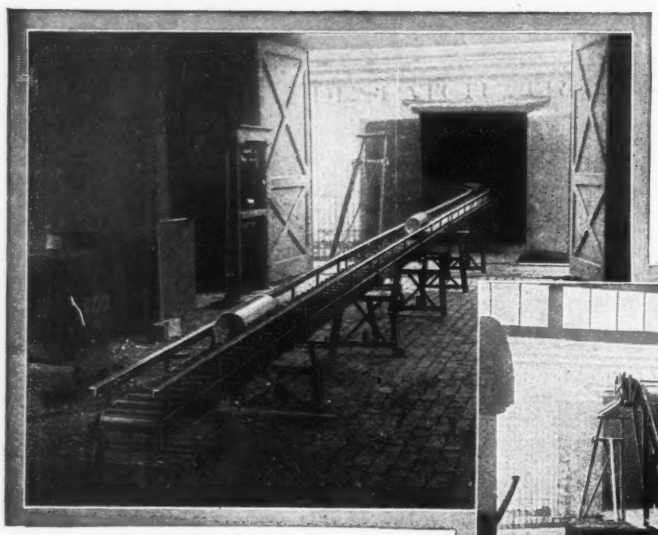
FOR HEAVY DUTY

FRICTION CLUTCH PULLEY

We lay out, make the drawings, furnish the material and erect it. Special machinery built to drawings and specifications.

WORKS:—ELIZABETHPORT, N. J.

"How can we speed up the work on our Shell Contract?"



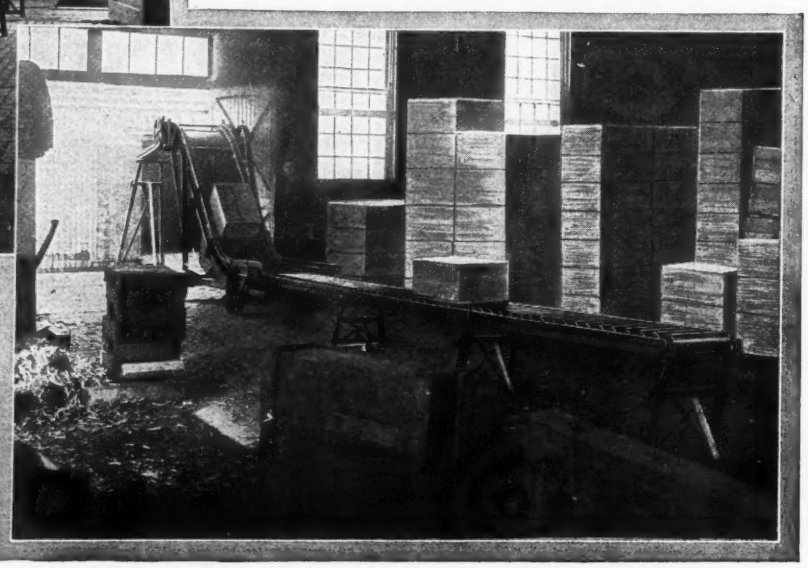
"How can we handle the forgings faster and route them through the plant without waste of time and labor?"

"How can we do away with trucking and unnecessary handling of raw and finished products?"

These problems are being put up to us every day, and many prominent concerns having war contracts can testify that we have solved them. If you are still struggling along in the old expensive way, let us install a system of

Mathews Gravity Conveyers

Designed to fit your needs



Gravity Roller Conveyer Delivering Shell Forgings from cars into plant

There's a MATHEWS CONVEYER for Every Handling Requirement—

MISCELLANEOUS MERCHANDISE in boxes, barrels, crates, cartons, cans, sacks, etc.

BRICK, Tile, Slate, Building Blocks, etc.

LUMBER, Lath, Shingles, Flooring, Staves, R. R. Ties, etc.

PIG IRON, Fire Brick, Billets, Bars, Angles, Sheets, etc.

Ask for Catalog "L" and tell us what you want to handle.

Gravity Roller Conveyer and Automatic Inclined Elevator Conveying Boxes of Shells from packing room to cars

MATHEWS GRAVITY CARRIER CO., Main Office and Factory: ELLWOOD CITY, PA. Branch Factories: Toronto, Ont. London, Eng.

Trahern Circulating Pumps

Simple, efficient, easily attached and adapted for the lightest water solution or for the heaviest oils. *Trahern Pumps fully cover every requirement for dependable and economical lubrication.* Flow is steady and free from vibration; automatic cut-off at supply without stopping pump a valuable feature; no expense for maintenance.

The correct pump for every type of machine is included in the Trahern line of service pumps.

Write us your requirements

Trahern Pump Company

Rockford ***Dept. 10*** **Illinois**

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Whatever your requirements for

SPRINGS

our Service Department can design them properly for you, and our springs will give unexcelled service.

Ask for Booklet 7-I.

Established 1857

THE WALLACE BARNES CO.

South & Parallel Sts., BRISTOL, CONN.

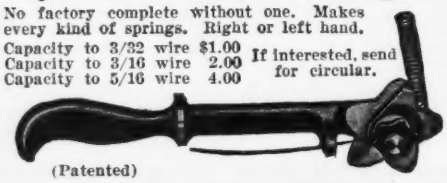
Mfrs. of Small Springs of every description, Screw Machine Products, Spring Washers, Stampings, etc. Dealers in Spring Steel and Wire.

Hjorth Perfection Spring Winder

No factory complete without one. Makes every kind of springs. Right or left hand.

Capacity to 3/32 wire $1.00
Capacity to 3/16 wire 2.00
Capacity to 5/16 wire 4.00

If interested, send for circular.



(Patented)

Hjorth Lathe & Tool Company

27 School St., Boston, Mass.

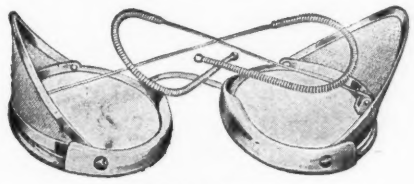
Works: Woburn, Mass.

We Can Fill Every Need for Effective Eye Protection

For extra hazardous work

Willson Safety Glass with "Super-Tough" Lenses

Affords adequate protection from heavy flying fragments, such as nuts, large chips, rivets, etc.



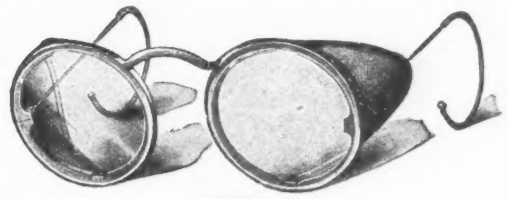
STYLE SSG2N

The highest type of eye protection—a special Willson grade, with adjustable bridge, safety flange and the new **Super-Tough** ground and polished lenses. Broad nose rest further distributes weight over face. $1.75 each; $10.25 per doz. Discounts on quantities.

For ordinary hazardous work

Willson Safety Glass, Style SG2

The time-tried goggle for ordinary chipping and power hammer work. The all-around eye saver.



STYLE SG2

Used for medium chipping and semi-heavy work. Same frame, half cable temples and wire screen side guards as SSG2N, but without extra wide nose rest. SG2 has thick, ground and polished lenses. $1.25 each; $8.00 per dozen. Discounts on quantities.

Let us advise you — There's no obligation

WILLSON SAFETY GLASSES
REG U.S. PAT. OFF.

Send for our new Safety Glass List

Elastic head bands furnished instead of half cable temples at same price

T. A. WILLSON & CO., Inc., READING, PA.

Chicago, Mallers Bldg. San Francisco, Head Bldg. Toronto, 23 Scott St.

No Regrets When You Use Brubaker Tools

A man deserves what he gets when he accepts "just as good" tools; but he gets what he deserves when he passes up that class and buys the best—Brubakers—the tools that have long since, by their unfailing accuracy and durability, won the confidence of discriminating tool users everywhere.

No inferior material, workmanship or methods ever enter into Brubaker construction—a way we have of living up to the reputation our line of Taps, Dies and Reamers enjoys.

Catalogue tells more about them. Write.

W. L. BRUBAKER & BROTHERS

MILLERSBURG PA., U. S. A.

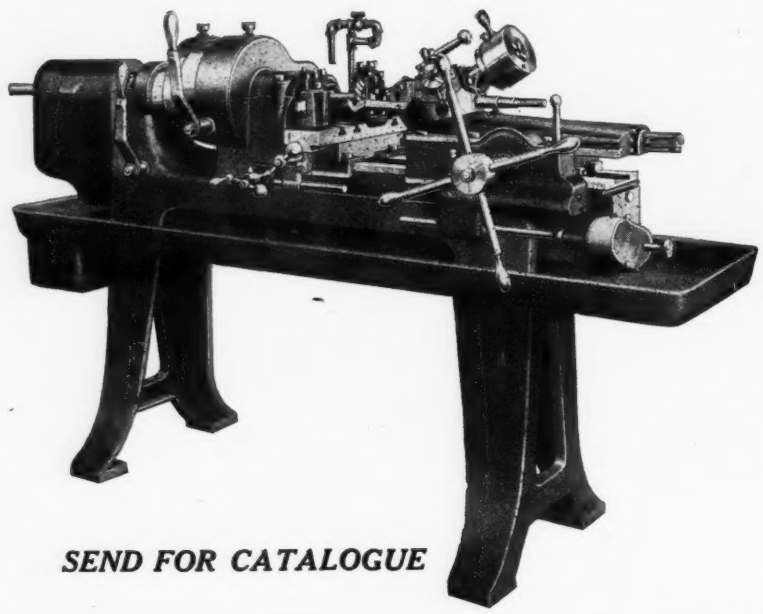
EASTERN REPRESENTATIVES: F. E. Harrison, 50 Church Street, New York. W. Searls Rose, 50 Church Street, New York.

THE TILTED TURRET

Turret Lathe and Screw Machine

Built in all sizes for manufacturing from a pin to a locomotive, for either bar work or chuck work. We have specialized for the past ten years in building THE TILTED TURRET turret lathes and screw machines and tools only.

WOOD TURRET MACHINE CO.
BRAZIL, IND.
U. S. A.



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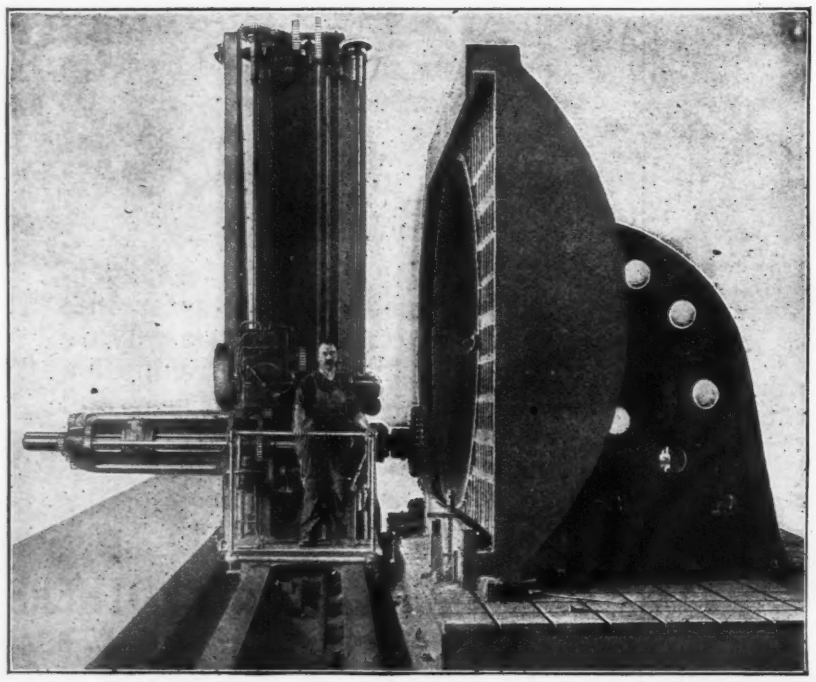
THE TILTED TURRET

Turret Lathe and Screw Machine

William Sellers & Co., Incorp. Philadelphia, Pa., U.S.A.

LABOR SAVING MACHINE TOOLS



In our Boring, Drilling and Milling Machine, the mechanism for adjusting the spindle, drilling head and upright, and for operating the speeds and feeds, is controlled by the operator directly at the drilling head, thus insuring rapid manipulation. Spindle is carried close to upright, giving great stiffness under cut. Vertical and horizontal power feeds are provided covering a wide range. Direct drive by endless belt avoids use of bevel gears and long transmitting shafts. Upright traversed by revolving nut on stationary screw. Applicable to great variety of work.

TOOL GRINDERS—SHAFTING—INJECTORS—DRILL GRINDERS

Thor

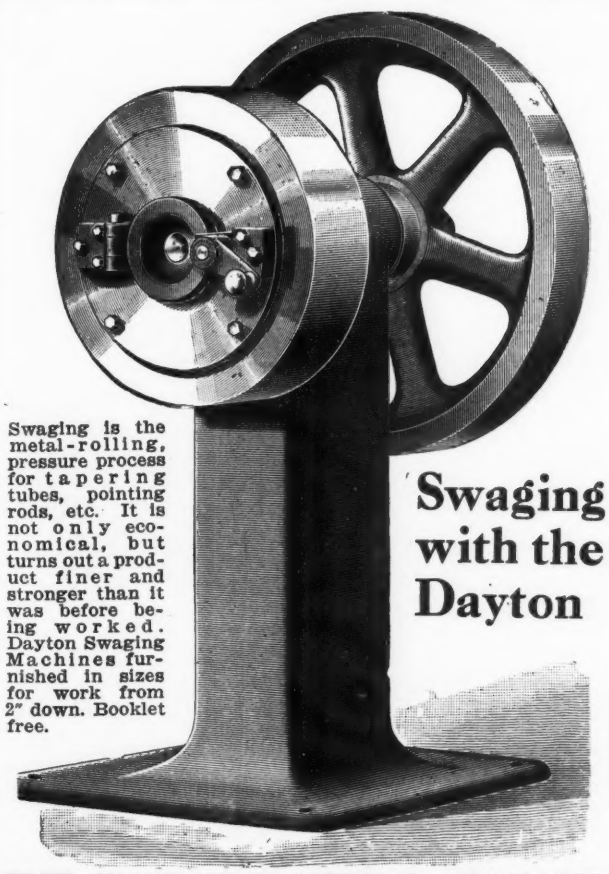
The Hammer That Can't Come Loose

Made from a solid drop forging, there is no coupling between the barrel and handle. No leakage of air at this point and the operator does not have to stop his work to tighten the handle.

Shipped on Trial—Free

Independent Pneumatic Tool Co.

Chicago New York Pittsburgh San Francisco
Montreal Detroit Birmingham



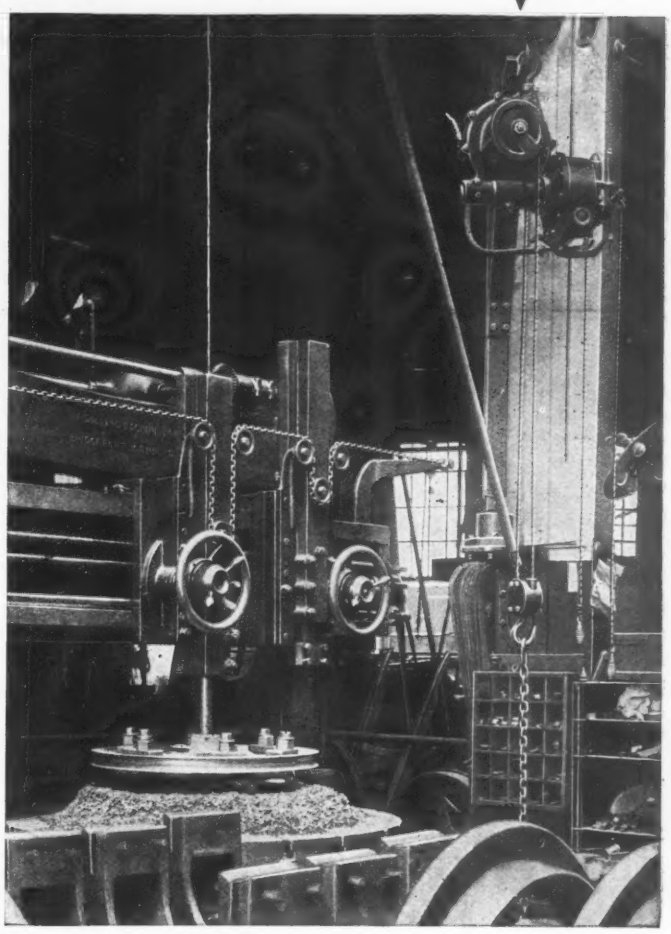
Swaging is the metal-rolling, pressure process for tapering tubes, pointing rods, etc. It is not only economical, but turns out a product finer and stronger than it was before being worked. Dayton Swaging Machines furnished in sizes for work from 2" down. Booklet free.

Swaging with the Dayton

THE EXCELSIOR NEEDLE COMPANY
TORRINGTON, CONNECTICUT

Coventry Swaging Co., Ltd., White Friars Lane, Coventry, England, Agents for Great Britain. Fenwick Freres & Co., 8 Rue de Rocroy, Paris, France, Agents for France, Italy, Belgium, Spain, Portugal and Switzerland.

FEEDING THE HEAVY MACHINE TOOL



You can increase the efficiency of the operator and raise the capacity of your heavy machine tools by using "Imperial" Air Hoists to serve them.

This hoist attached to a swinging arm or wall crane will lift and place the work without assistance from other machine-tool operators as only the time of the individual machine-tool operator is required and he is enabled to do the work easier, better and more quickly.

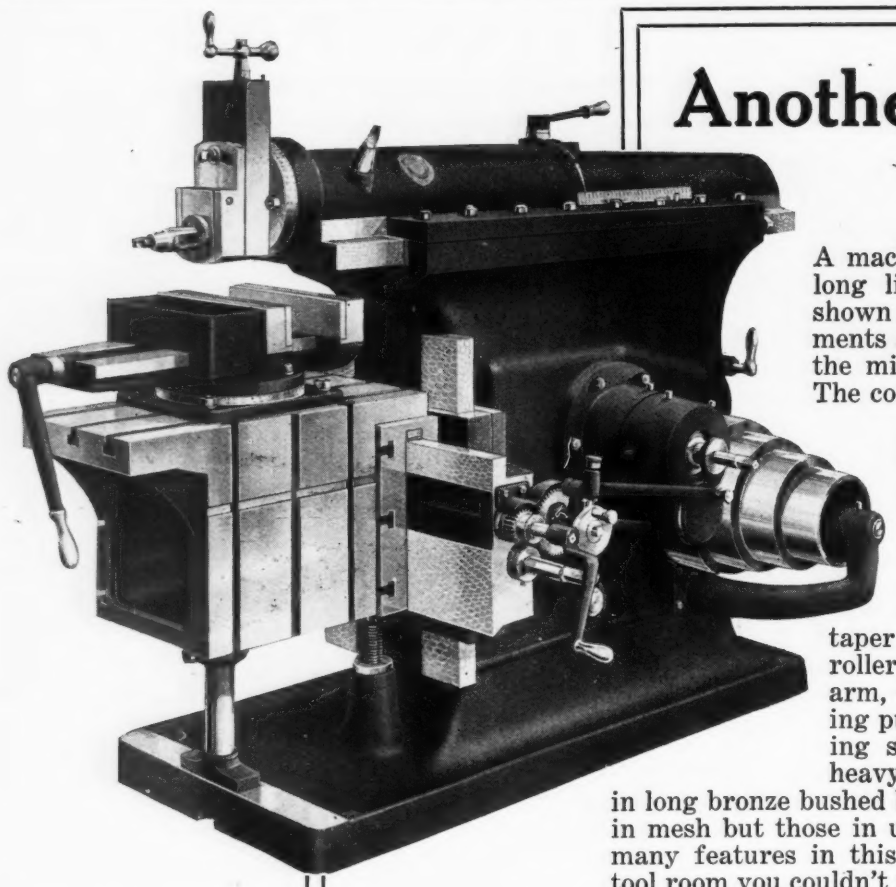
"Imperial" Air Hoists are self-locking in any position and self-stopping at end of lift. They are economical of power and durable in construction and are built in 5 sizes up to 5-tons capacity.

Bulletin 8006.

INGERSOLL-RAND CO.

New York Offices the World Over London

23-H



Another Rockford Success

A machine that will add many to the long list of Rockford enthusiasts is shown herewith. All the new improvements are embodied—everything up to the minute for modern requirements. The compact, sturdy lines of the

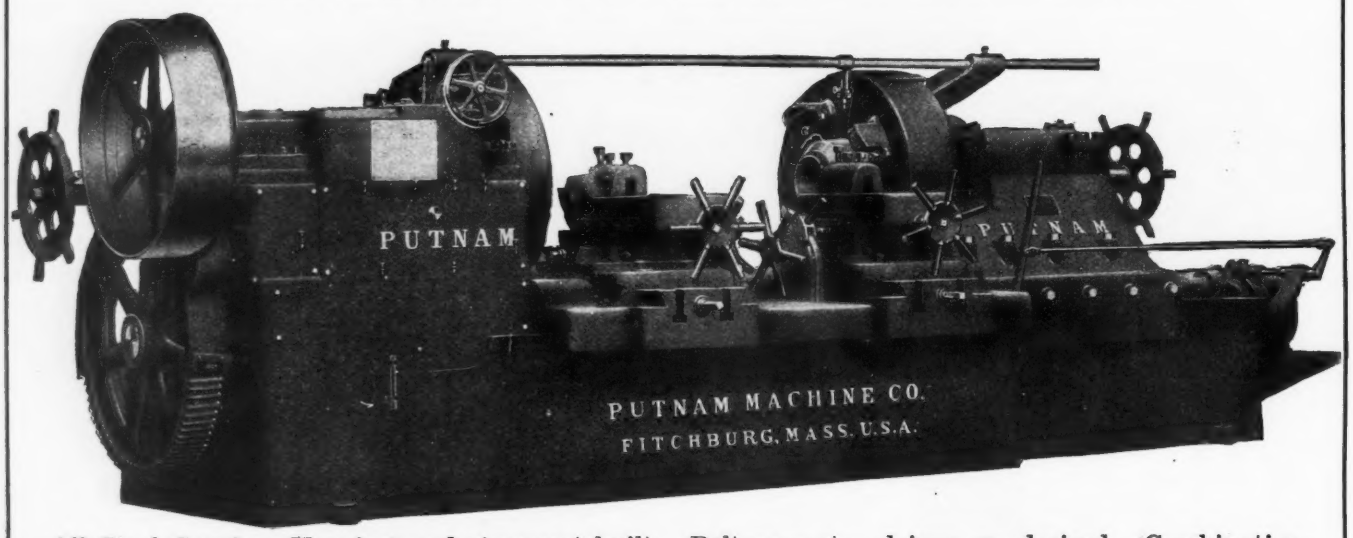
Rockford 24-inch Back Geared Crank Shaper

tell the story of rugged power and the ability to get heavy work out on time. Full length taper gibs, heavy arched ram with roller bearing on new style rocker arm, staunch outer support for driving pulley to prevent belt pull springing shaft, square bearings on ram, heavy shafts of high carbon steel run in long bronze bushed bearings, steel pinions, no gears in mesh but those in use—these are but a few of the many features in this efficient shaper. For shop or tool room you couldn't make a wiser investment.

Send for descriptive circulars.

Rockford Machine Tool Co., Rockford, Ill.

PUTNAM
Latest Pattern 42" Coach Wheel Lathe

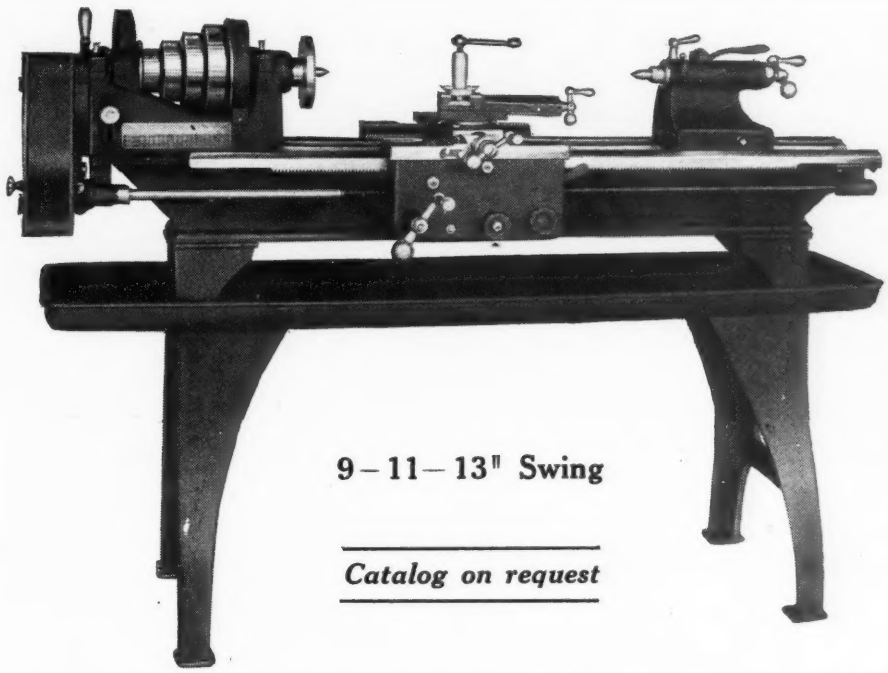


All Steel Gearing. Heaviest and strongest built. Belt or motor driven, as desired. Combination Tool Holders. Putnam Driving Dogs. Automatic Tailstock Binding Device. Calipering Device.

Machine Shop and Foundry Equipment of Every Description

MANNING, MAXWELL & MOORE, INC.
119 WEST 40th STREET, NEW YORK

Boston Buffalo Chicago Cincinnati Cleveland Detroit Milwaukee
New Haven Philadelphia Pittsburgh Seattle St. Louis San Francisco Yokohama, Japan



9—11—13" Swing

Catalog on request

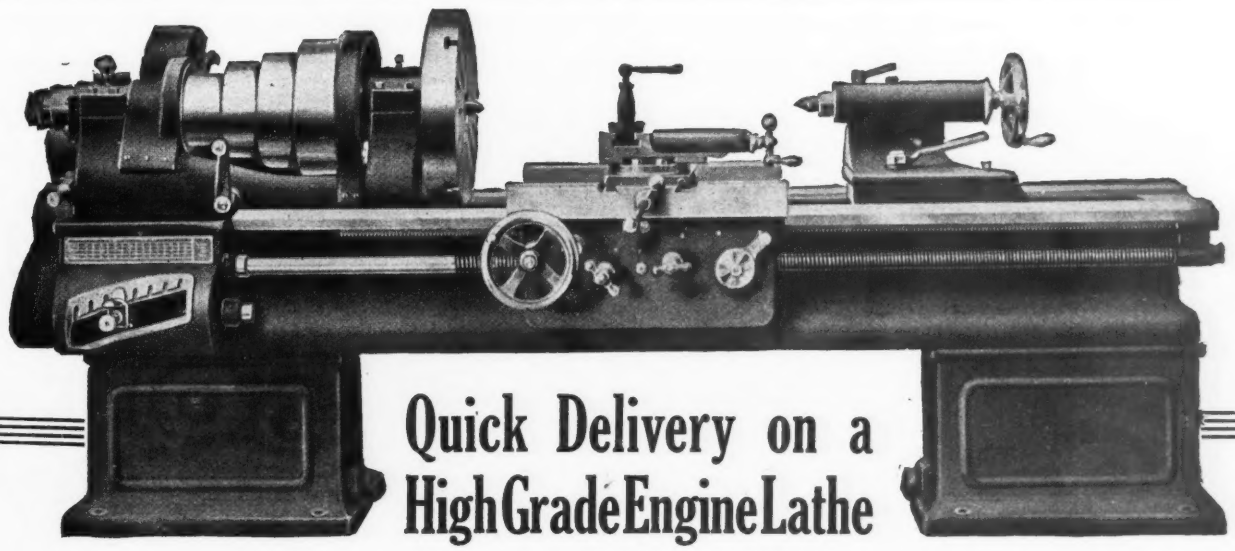
Tool Room "Stars"

"Star" Lathes are built for business, no fancy finishings or superfluous parts; but great care is taken in emphasizing those features that produce results. The work they turn out leaves nothing to be desired, and proves the soundness of the principles of "Star" construction. They are well adapted for tool room purposes, where they can be depended upon for consistent service. "Star" Lathes are rapid, rigid, accurate, low-cost machines which give lasting service. Many big concerns in all the prominent lines of manufacture use them, both for tool room and manufacturing purposes. Let us tell you where you may see them in operation.

THE SENECA FALLS MANUFACTURING COMPANY

330 WATER STREET **SENECA FALLS, NEW YORK**

Canadian Sales Agents: The Canadian Fairbanks-Morse Co., Ltd., Montreal, Toronto, St. Johns, N. B., Calgary, Saskatoon, Winnipeg, Vancouver, Edmonton, Fort William, Hamilton, Ottawa, Quebec, Regina, Victoria.



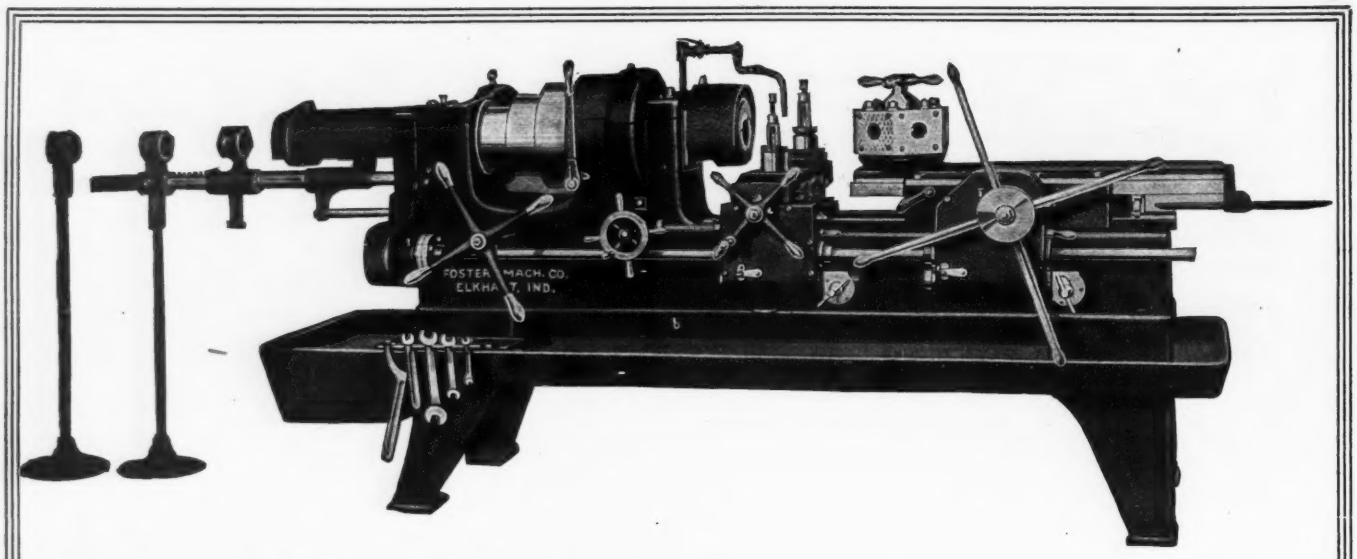
Quick Delivery on a High Grade Engine Lathe

GOOD lathes are hard to get in these busy days. So when we are able, through large facilities, to offer August and September deliveries on this Davis 22″ x 10″ Quick Change Engine Lathe, manufacturers in need of lathe equipment should be prompt to take advantage. The Davis is a well-known high-grade engine lathe with positive feed and double back gears—a stocky, powerful machine that will turn 9″ shells successfully. Orders are coming in fast.

Better get in touch with us at once.

BUFFALO CONTRACTORS' PLANT CORPORATION, Buffalo, N. Y.

NEW YORK OFFICE, Hudson Terminal Building, 30 Church Street, C. E. FORSYTH, Manager, Phone 340 Cortlandt

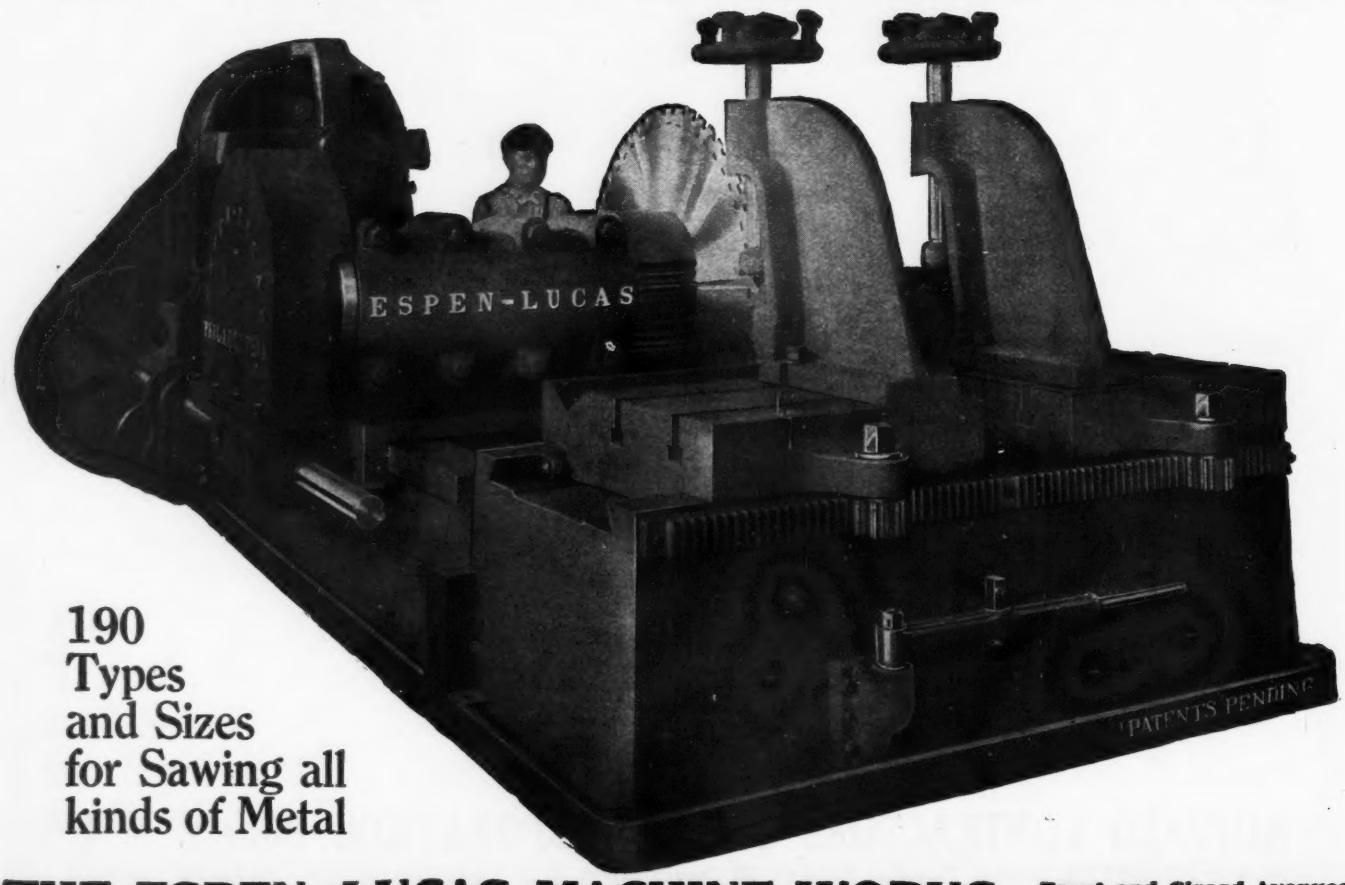


Durable Accuracy

Most machines are accurate when you buy them, but how long do they stay so? Hard service is the test of good design and honest construction. Foster Screw Machines are accurate when they leave our factory and they remain so through years of service. Their perfect alignments are maintained through rugged supports for all parts subject to stress—one reason for the "Foster" being 25 per cent heavier than any competitive make of the same size. Accuracy that counts in producing duplicate parts is the big "Foster" feature. You will find many other advantages in this machine you cannot find elsewhere. Ask us about them.

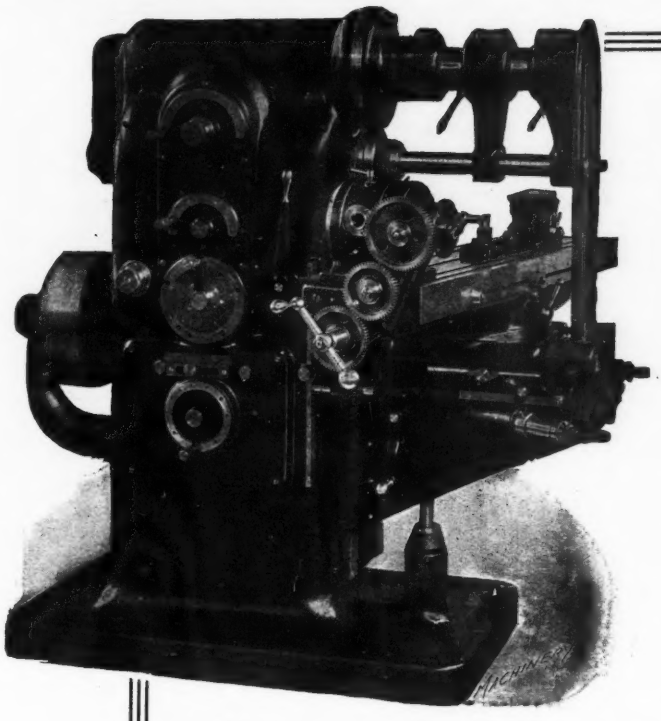
FOSTER MACHINE CO., Elkhart, Ind.

One of the Fastest Cold Sawing Machines in the World



190
Types
and Sizes
for Sawing all
kinds of Metal

THE ESPEN-LUCAS MACHINE WORKS, Front and Girard Avenues PHILADELPHIA, PA.



For *Your* Tool Room

Would you be interested in a milling machine that would enable your toolmakers to do better work and more of it—a machine that was accurate enough for the finest tool work and powerful enough for general manufacturing? Naturally you would, and

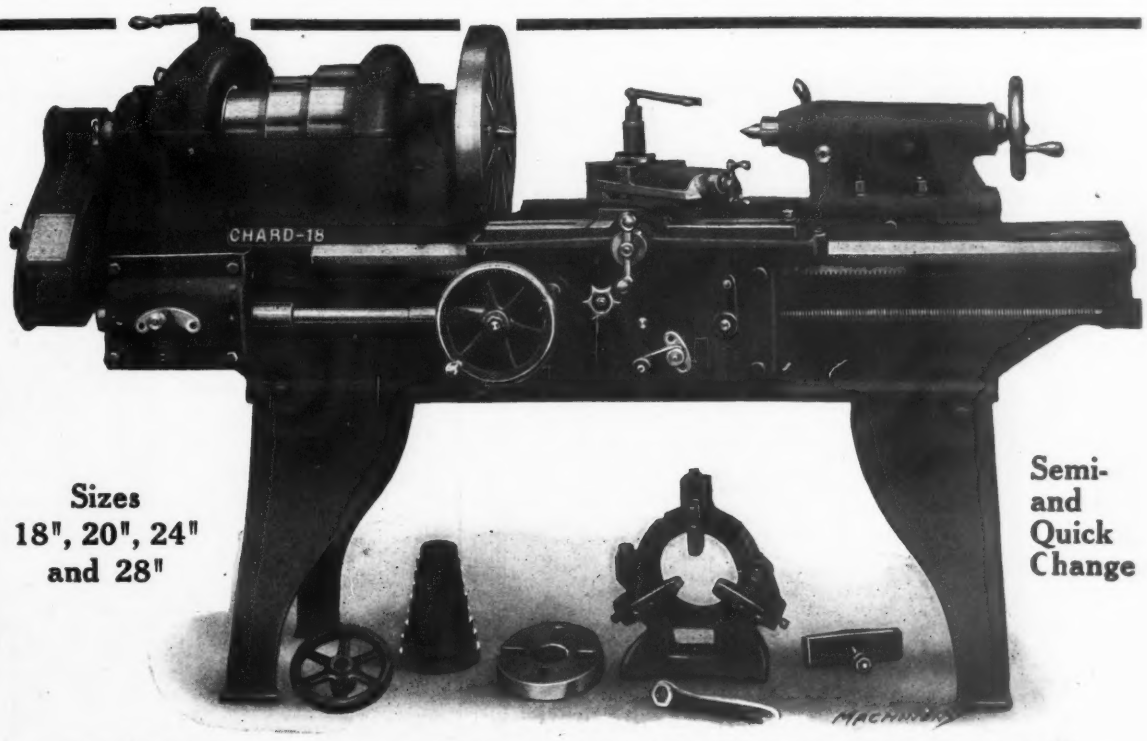
No. 2 Rockford Universal Miller

is the machine to investigate. This sturdily designed miller has a powerful constant speed drive, from which an abundance of power is transmitted to the spindle. Knee, saddle and table are of generous proportions, and are solidly supported. Back gears located inside frame at the front, giving a drive of immense power and preventing vibration and chatter. A wide range of independent speeds and feeds is quickly obtainable through simple quick-change gear mechanism conveniently located at the side of the machine. Write for further details.

ROCKFORD MILLING MACHINE CO., Rockford, Ill.

CHARD

The Lathe Unusual



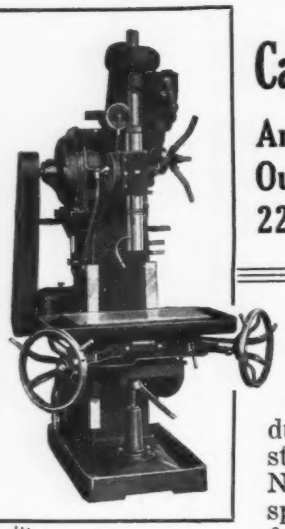
Sizes 18", 20", 24" and 28"

Semi- and Quick Change

IN designing this machine we made a number of important departures from standard lathe design. It is the heaviest lathe of its size on the market—a stronger machine throughout. We believe we have the best lathe spindle possible to produce. The ways of the bed are chilled 5/8" below the surface—longer wear, permanent alignment. No gears in apron running on fixed studs. Three-point suspension for bed, no warping or springing. Handles revolve on fixed studs, not in operator's hands. *Let us tell you all about them.*

CHARD LATHE COMPANY, New Castle, Ind., U.S.A.

AGENTS: Vonnegut Machinery Co., Indianapolis, Ind. English and Miller Machinery Co., Detroit, Mich. The W. M. Pattison Supply Co., Cleveland, Ohio. M. S. Zortman Machinery Co., Pittsburgh, Pa., The E. A. Kinsey Co., Cincinnati, Ohio. Federal Machinery Sales Co., Chicago, Ill.



Capacity and Endurance

Are Outstanding Qualities of Our Self-oiling, All-geared 22-inch Drill and Tapper

A great machine for manufacturing shops. Maximum strength, power, speed and productive capacity. Alloy steel, heat treated gears. No belts. Eight geared speeds and ten geared feeds, all under instant control. All gears and their bearings are continuously oiled automatically. Handles high-speed twist drills from ½″ to 2″.

Furnished with or without motor drive; with or without compound table here shown.

Send for complete catalog "M."

BARNES DRILL COMPANY

814 Chestnut St. Incorporated 1907 **Rockford, Ill.**

EXCLUSIVE MANUFACTURERS

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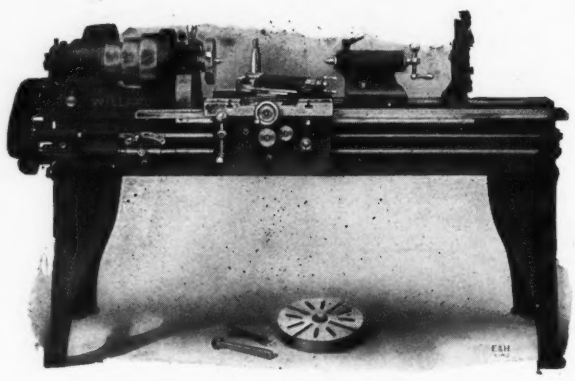


The Willard High Powered 13" Engine Lathe

Designed and constructed to withstand the strains imposed through the use of modern high-speed steel tools, and provided with extra powerful feed. The Willard Lathe handles a variety of work entirely outside the regular small lathe range. It is built on precision lines and fitted with operating helps of latest and best design.

"Willard" output is always high, always accurate. "Willard" costs are always low.

If you need an all-around lathe for tool-room, shop or for manufacturing, look up the "Willard."

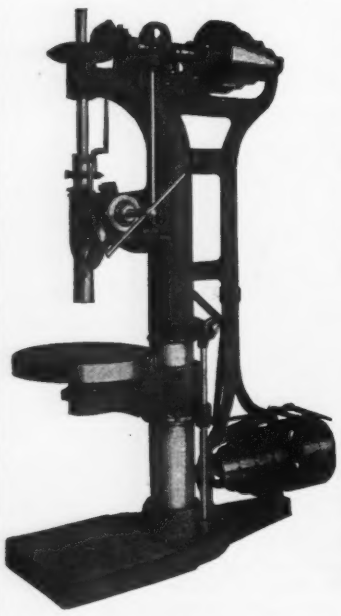
Full description on request

THE WILLARD MACHINE & TOOL CO.

CINCINNATI, OHIO

SIBLEY

The Drill of Utmost Economy



A stationary head machine with positive geared feed. It will cut drilling costs to a minimum.

We Make Drills Only

A complete line from 16″ to 30″ swing, stationary, sliding, and traveling head.

Write for Catalog.

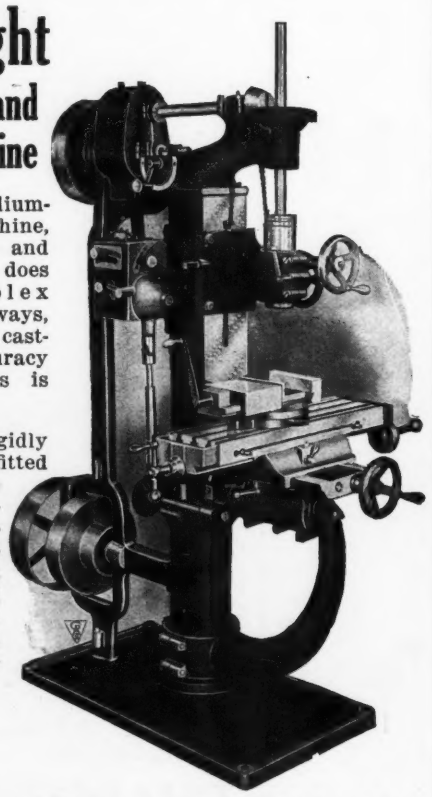
SIBLEY MACHINE COMPANY

8 Tutt St., South Bend, Ind., U. S. A.

A Small Shop in Itself

The Knight

No. 2 Milling and Drilling Machine



Answers for medium-sized turret machine, slotter, miller and drilling machine; does plain and complex drilling, cuts keyways, faces and finishes castings, and the accuracy of all operations is guaranteed.

Machines are rigidly constructed and fitted with every device to save time; controls are centralized; table can be tilted to almost any angle, and work milled, drilled, bored, etc., by simply changing tools.

Three Sizes. Write for Circulars.

W. B. KNIGHT MACHINERY CO.

2019-25 LUCAS AVE. **ST. LOUIS, MO., U. S. A.**

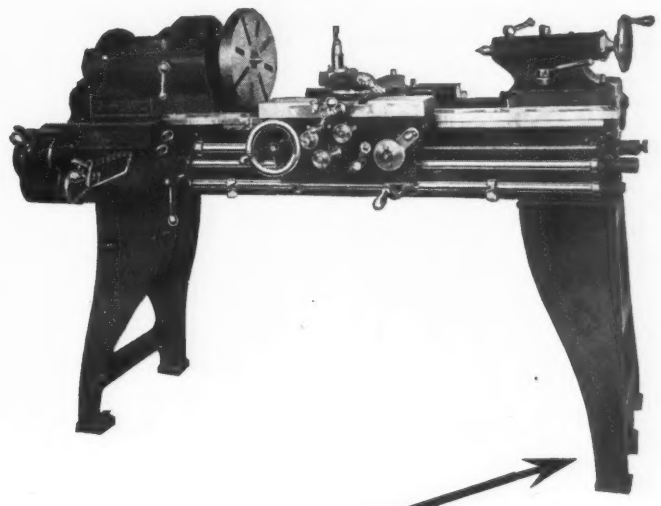
Coats Mch. Tool Co., Ltd., London, Glasgow and Newcastle-on-Tyne; R. L. Scrutton & Co., Sidney, Australia.

THREE-POINT SUPPORT

means perfect alignment for

DAVIS 12-INCH CLOSE COUPLED

Tool Room Lathe



Write for our Catalog.

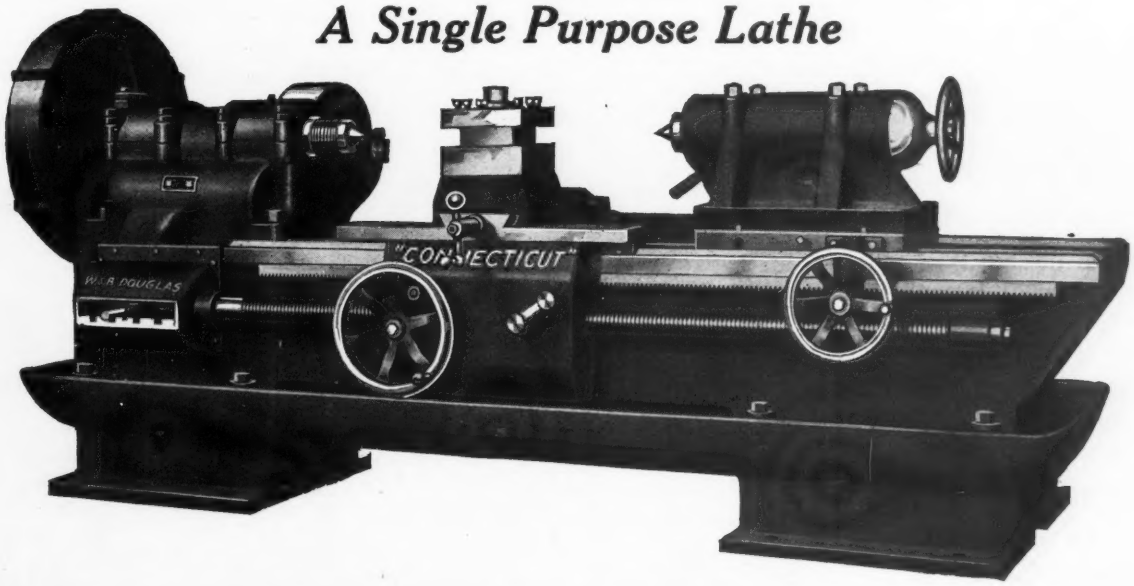
DAVIS MACHINE TOOL COMPANY, Inc.

Rochester, N. Y., U. S. A.

THE CONNECTICUT LATHE

is the machine to install for turning high carbon steel at high speed or for heavy turning of any kind. It's a machine of liberal dimensions built to withstand the strains of hard service. Diameters of shafts and spindles and length of bearings are far beyond ordinary practice. All bearings are fitted with renewable bronze bushings. Lubricating system is efficient and complete. The "Connecticut" is a top-notcher on production, accurate under all conditions and does its work at remarkably low cost. Write for particulars.

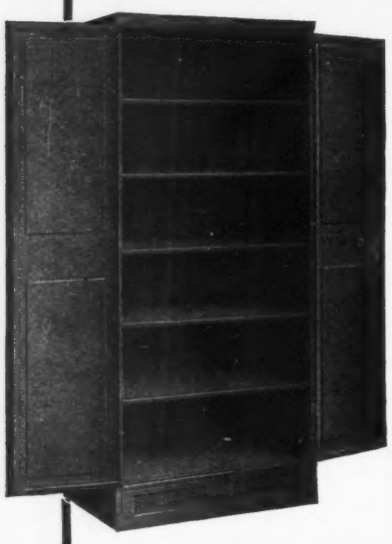
A Single Purpose Lathe



W. & B. DOUGLAS, Middletown, Conn., U. S. A.

Terrell's Sectional Steel Fixtures

Are being installed by up-to-date concerns who realize that wooden fixtures belong to yesterday in business; and in no instance, when installed, have Terrell's failed to prove their superiority and economy.



Terrell's Steel Fixtures take up less space, are standardized, interchangeable and fireproof. They are easily adjusted, are practically indestructible, and meet all requirements. Line includes Shelving, Racks, Bins, Cabinets, Drawers, etc.

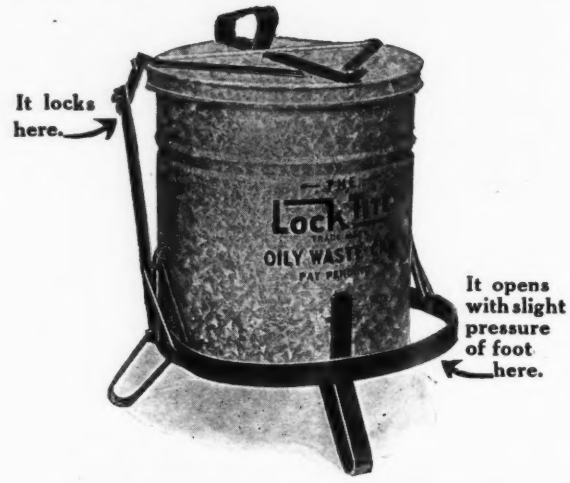
Receipt of specifications will enable us to quote on an installation. WRITE US TODAY.

TERRELL'S EQUIPMENT COMPANY
SOUTH GRAND RAPIDS, MICHIGAN

Fire Prevention is Better Than Compensation

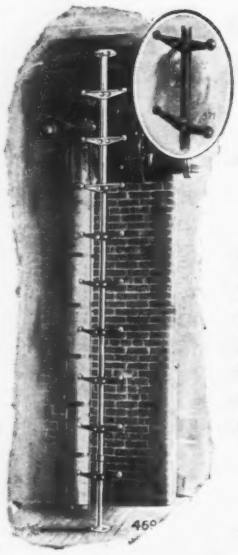
Spontaneous combustion resulting from overturned cans is eliminated by use of

LOCK TITE OILY WASTE CANS



Your employees will appreciate the Lock Tite Service. It's really fun to operate them. Drop a post card today for details and prices.

KEYES-DAVIS COMPANY, Inc.
Dept. C 10 BATTLE CREEK, MICH.



Convert any Existing Pipe into a Ladder
WITH
"New Britain"
Adjustable Rungs

There are any number of places throughout the plant where you could use these rungs instead of an unstable wooden ladder. Clamped to any pipe—can't slip, and hold enormous weights.

Bench Legs
—they're "New Britains"

These legs have a patented stringer construction that permits of wider spacing without sacrificing rigidity. Adopted by many large concerns who have found "New Britain" Bench Legs substantial, serviceable and economical to use.

Write for the "New Britain" catalog.

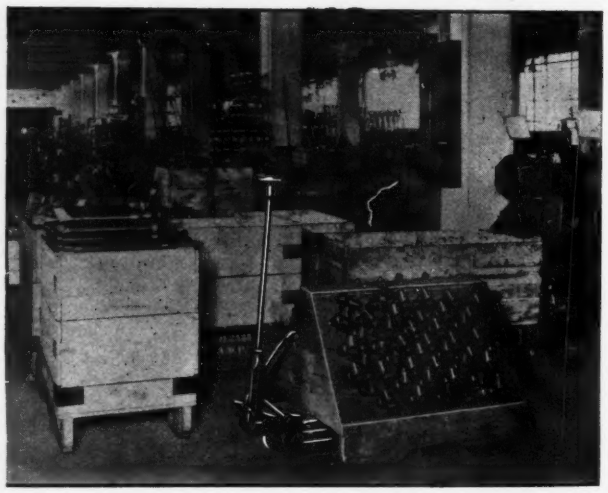
The New Britain Machine Company
Shop Furniture Originators
64 Bigelow St., New Britain, Conn.

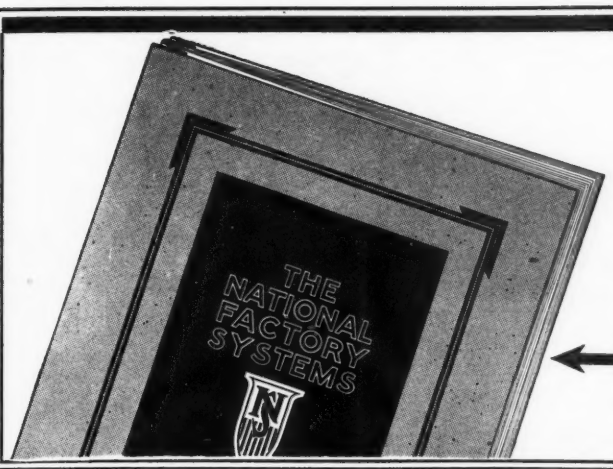
The Right Truck for Light Loads

The Clark Three-wheel Transfer Truck is designed for economical handling of loads up to 1000 pounds, and for operation in close quarters. It has wide roller-bearing wheels, top frame with 1⅞-inch elevation, is light in weight, strongly constructed, and easy to operate. Thirty days' trial offered responsible parties. *Bulletin L-37 on request.*

Price, $28.00

The George P. Clark Company
Windsor Locks, Connecticut





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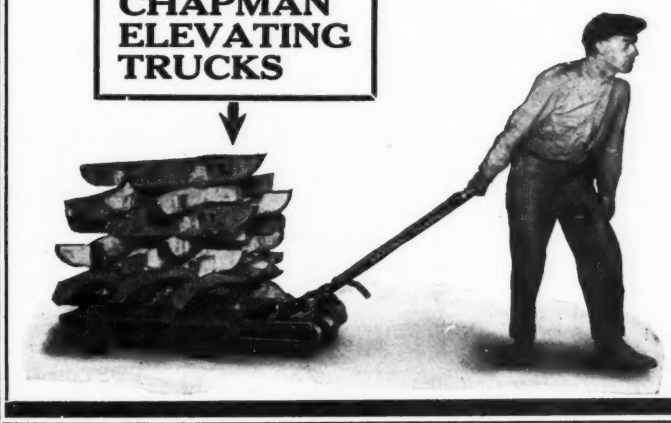
NATIONAL COUNTING MACHINES

NATIONAL-CHAPMAN ELEVATING TRUCKS

A 500-Foot Haul—Then What?

Well, That Depends on the Kind of Truck



If it's a National-Chapman, the operator simply presses the handle release—the loaded platform gently sinks to the floor—the truck rolls smoothly from underneath and the trucker is off to pick up another load. His business is hauling—only.

But what a different story if it's a platform truck that must be unloaded, so that the operator can use it again. He made the 500-foot distance in 2 minutes—but now he spends 10 minutes or more unloading—time wasted.

It is perfectly obvious that the trucking system which involves hauling only will save the biggest part of your trucking expense.

That's why it will pay you to investigate the powerful, handy National-Chapman Elevating Truck.

NATIONAL SCALE COMPANY

6 Mechanic Street **CHICOPEE FALLS, MASS.**

Hyatt Roller Bearings Used Exclusively on Trucks

Getting Capacity Out of your Tools?

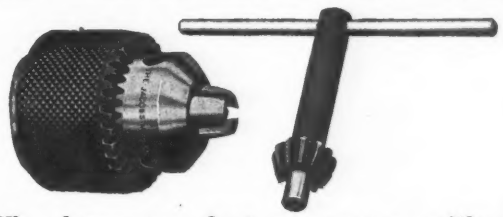
If you are not, it's time you investigated the Millholland Quick-change Chuck. It is designed especially for speeding up drilling, reaming, boring and tapping operations by permitting the rapid change of drills, reamers, taps, etc., while the machine is running. It is very easy to operate, is simply constructed, dirt-proof, and practically indestructible. Furnished in nickel or vanadium steel.

Folder for details.

W. K. Millholland Machine Co.

Indianapolis, Indiana, U. S. A.

Our Customers Know Why!



Why have our first customers, without solicitation, continuously and increasingly purchased **Jacobs Improved Drill Chucks?**

Our Illustrated Catalog M sent upon request

THE JACOBS MANUFACTURING CO.

HARTFORD CONN., U. S. A.

The Chuck You Need for Driving High Speed Drills

The Pratt Positive Drive Drill Chuck is especially adapted for this class of drilling. It holds the drill securely, drives it at high speed without danger to work or tool, and leaves the drill shank clean and free from scar.

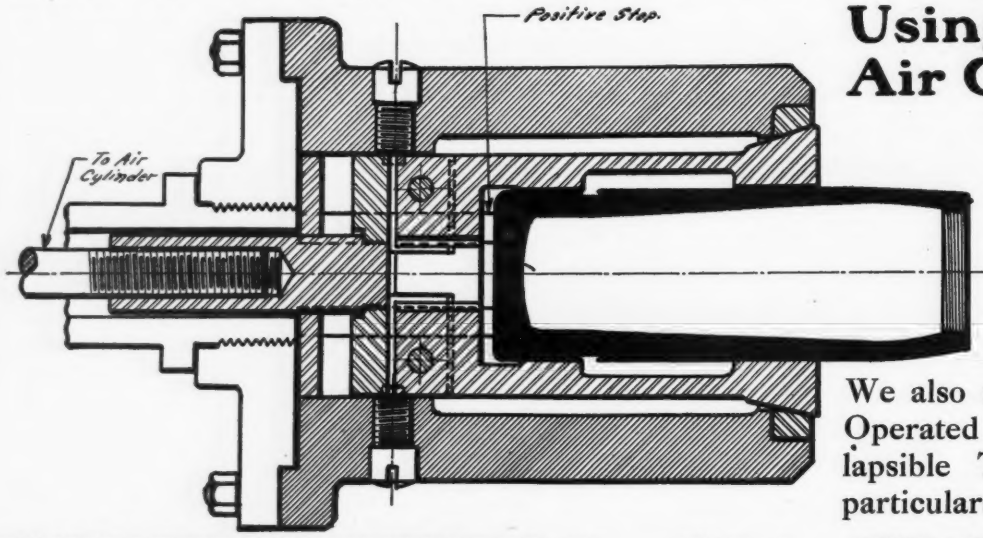
Specify Pratt Chucks in your next order.

THE PRATT CHUCK COMPANY

FRANKFORT, N. Y.

EUROPEAN AGENTS: Selson Engineering Co., Ltd., 85 Queen Victoria Street, London, England.

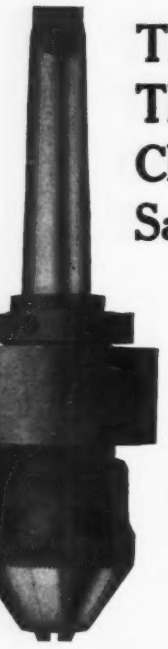
You Will Get More Work in Less Time by Using "M.E.C." Air Chucks



"M. E. C." Air Operated Hinge Collets furnished for shells and parts up to 9.2" in diameter.

We also manufacture Air Operated Mandrels and Collapsible Taps. Write for particulars.

MANUFACTURERS EQUIPMENT CO., 175 North Jefferson St. **CHICAGO, ILL., U. S. A.**



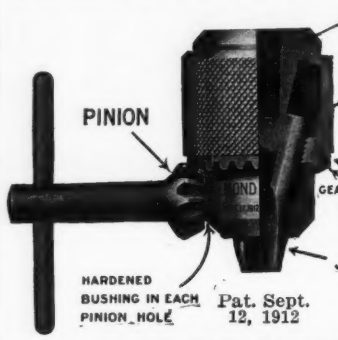
The New Bicknell-Thomas Tapping Chuck is a Cost Saver

Distinctive features include friction which slips under strain in a way that makes tap breakage practically impossible, driving power exactly suited to size of tap, and ability to work within the smallest compass on multiple spindle machines. The Bicknell-Thomas is simple in design and reliable in operation. Furnished in five sizes. Capacities from 1/8" to 1".

Order your size on trial

BICKNELL-THOMAS COMPANY
GREENFIELD MASS., U. S. A.

ALMOND CHUCKS



POWERFUL
ACCURATE
DURABLE

COST LESS TO MAINTAIN

Ask Us Why

T. R. ALMOND MANUFACTURING CO.
2 MAPLE AVENUE ASHBURNHAM, MASS.
LONDON OFFICE: 8 White Street, Moorfields, London, E. C.

Skinner Independent Chucks

FOR HIGH SPEED WORK

IRON OR STEEL BODY

The last word in chuck construction.

Wide jaws; hardened steel thrust bearings; adjusting screws of large diameter, threaded full length; jaws ground after hardening, etc.

Write us today for prices.

THE SKINNER CHUCK COMPANY

New York Office: 94 Reade Street
San Francisco Office: Rialto Building
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Main Office and Factory
NEW BRITAIN, CONN.

If you want the best Lathe or Drill Chucks—buy Westcott's

Little Giant Auxiliary Screw Drill Chucks, Little Giant Double Grip Drill Chucks, Little Giant Improved Drill Chucks, Oneida Drill Chucks, Spur Geared Scroll Combination Lathe Chucks, Scroll Combination Lathe Chucks, Spur Geared Scroll Universal Lathe Chucks, IXL Independent Lathe Chucks, Cutting-off Chucks.

Strongest Grip Greatest Capacity
Great Durability and Accuracy

WESTCOTT CHUCK CO., Oneida, N.Y., U.S.A.

Spur Geared Scroll Combination Lathe Chuck

Ask for English, French, Spanish or German catalogue.

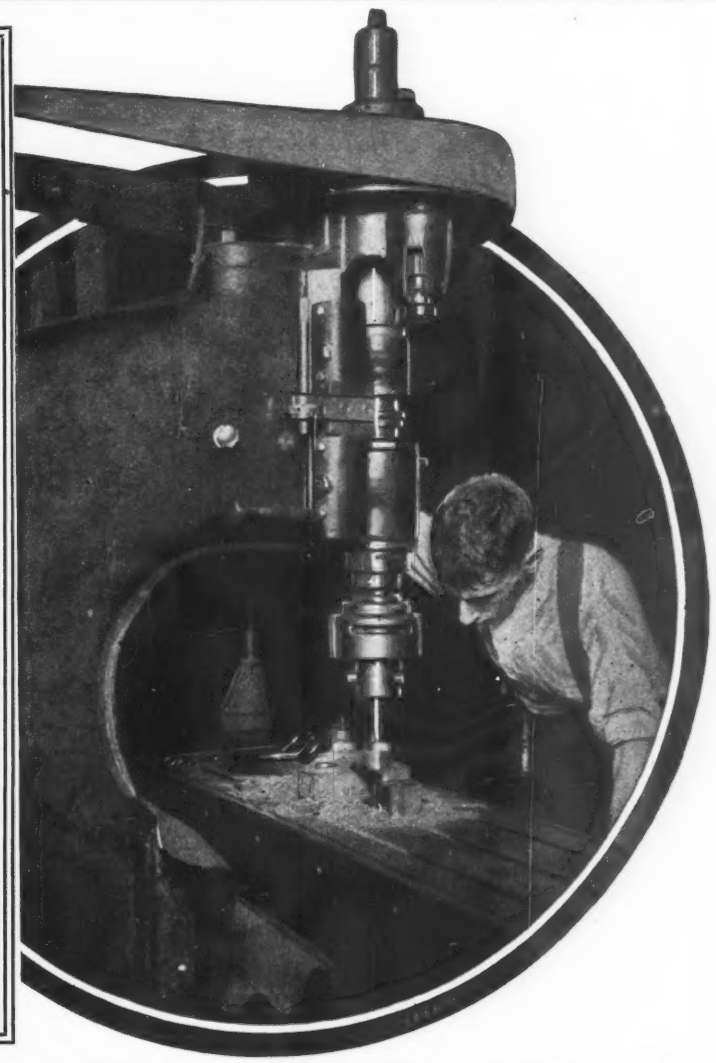
Little Giant Auxiliary Screw Drill Chuck

Dependable Boring Heads

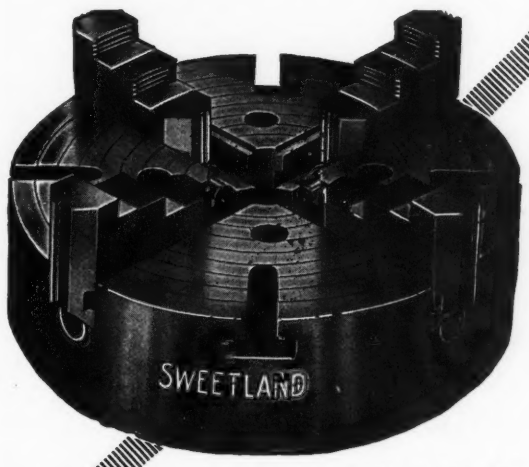
Holes in Jigs, Tools and Fixtures are now bored accurately to size by clamping the tool or fixture on the milling machine table and rotating the boring tool in the Casler Offset Boring Head. The new way enables you to save time and make use of the vertical and horizontal adjustment provided on the machine. The Casler Offset Boring Head allows quick and accurate adjustment of the boring tool.

Send for our Treatise on Boring, then order a Head and save time and money on your jig and fixture work.

MARVIN & CASLER CO.
CANASTOTA, N. Y.



Sweetland —the Chuck with the Bull Dog Grip

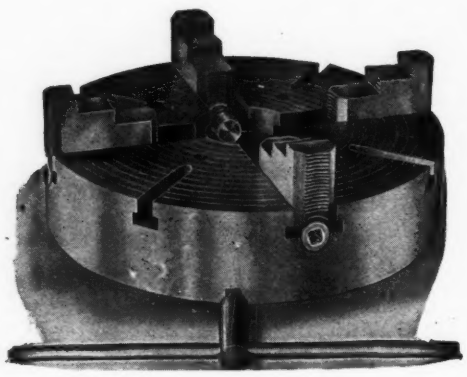


YOU ARE familiar with the proverbial grip of the bull dog. Perhaps you are also familiar with the reputation of Sweetland Chucks in this respect. If not it will pay you to learn. Their positive holding power has made them famous. No matter how heavy the cut, they never fail. Strong construction, deep, heavy jaws and perfect balance make the Sweetland a safe and dependable chuck. When you stop to consider the enormous strain to which a chuck is subject you will realize why so many manufacturers specify the sure chuck—the Sweetland.

Our booklet "Chucking for Profit" mailed on request

HOGGSON & PETTIS MANUFACTURING COMPANY
New Haven, Connecticut, U. S. A.

The Horton Habit



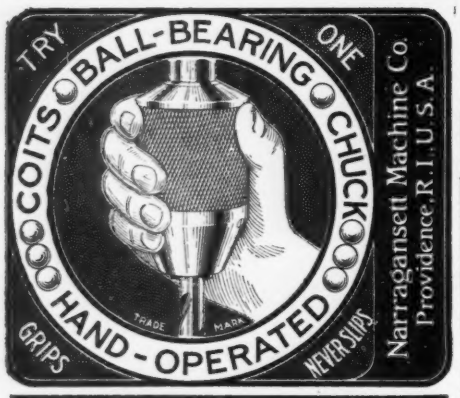
Not an accident, nor a coincidence, but a habit. The Horton habit of leading in chuck manufacture was formed 65 years ago with eyes wide open to future demands, and the way increasing requirements have been met proves that the Horton pioneers not only builded well, but that the original high standard has been maintained ever since. The "Horton" stamp on a chuck is a guarantee of reliability.

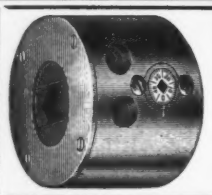
It's *always* safe to specify Horton's

We carry a full line of standard chucks and are prepared to furnish specials upon receipt of specifications.

Catalog for details

THE E. HORTON & SON CO., Windsor Locks, Conn.





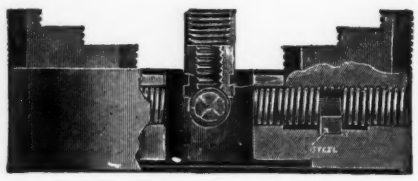
Micrometer Offset Boring Heads
to do your accurate boring. These boring heads take up very little room on your milling machines and have great range for boring. Send for catalog.
J. T. Flynn Mfg. Co.
DETROIT, MICH.

"WEAR-EVER" Tap Chuck

At last—a *practical* tap chuck. The "Wear-Ever" will hold and drive a tap *true* no matter what variation in the shank. As fully 90 per cent of tap breakage is due to taps not running true, the advantage of the "Wear-Ever" is strikingly apparent. No screws to adjust. A few seconds all that is necessary to change taps.

Circular and prices on request.

SCULLY-JONES & CO.
647 Railway Exchange Bldg., CHICAGO, ILL



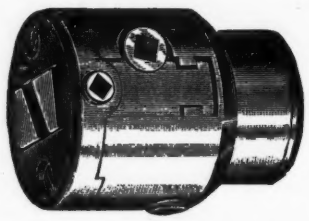
Solid Steel Rings Reenforce these Independent Lathe Chucks

making them strong where other chucks are weak, providing for tensile stresses and screw thrusts, insuring greater durability and better service.

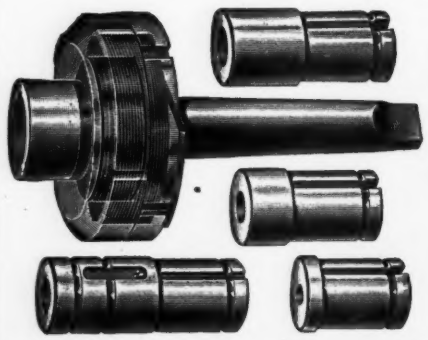
"National"
Round Body Drill Chuck

Made with three distinct grips which can be applied at the same time when necessary—a positive gripping chuck—all sizes up to 2 inches.

Catalog?



Oneida National Chuck Co.
ONEIDA, N. Y., U. S. A.



The
Safety Drill & Tap Holder

is the only attachment for the purpose that gives universal satisfaction and is

UNEQUALED in Efficiency, Convenience, Rapidity, Accuracy and Simplicity.

Nothing to break or get out of order. Made in 4 sizes, covering from 0 to 2½ inches diameter.

The Beaman & Smith Co., Providence, R. I.

1874 TRUMP DRILL CHUCK 1916

Write for prices and particulars

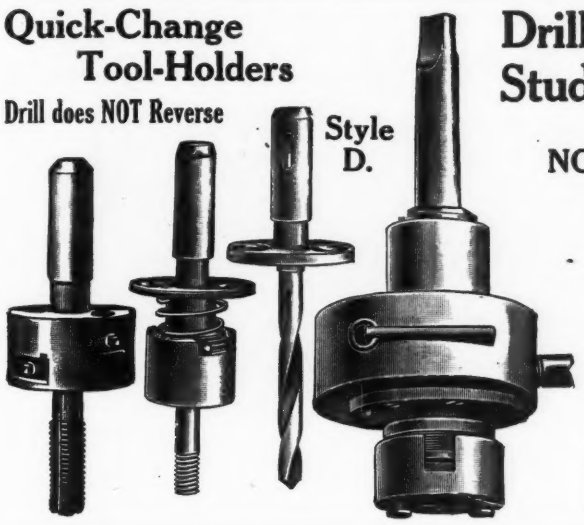
We have been making it for 42 years; it is still the BIG Chuck at the SMALL price; for Straight or Taper Shank Drills.

Three Sizes: No. 1 0 to ½" No. 2 0 to ¼" No. 3 0 to ⅝"

TRUMP BROS. MACHINE COMPANY, Wilmington, Delaware

Quick-Change Tool-Holders

Drill does NOT Reverse



Style D.

Drills, Taps, Sets Studs in Line

NO { Stopping / Reversing / Moving Work / Changing Speed

ERRINGTON

39 Cortlandt Street NEW YORK

136 W. Lake Street, CHICAGO

Auto-Reverse **TAPPING CHUCK**

FIFTEEN YEARS ON THE MARKET HAVE TAUGHT ME

Simple Methods of Handling Work

AND HOW TO ADAPT MY

Positive, Friction and Interchangeable Tapping Devices

TO MEET

Every Condition of Tapping

MADE IN ALL SIZES FROM 1-16-IN. TO 2-IN. TAPS.
Use Style D for work that is clamped down or work that is too heavy to center itself to the tap.

Deutsche Katalog von Arthur Kayser, Berlin, S. W., Oranienstr. 126, Agent fur Deutschland und Osterreich-Ungarn. Catalogue Francais: Edgar Bloxham, Paris, 12 Rue du Delta.

You Don't Have to Stand for Broken Taps—

The Woodstock Tapping Chuck

drives a tap to its limit, in any material, without breakage. Releases automatically the instant the tap strikes an obstruction or binds in the hole. Simple, dependable, durable.

Order a Woodstock Tapping Chuck on trial, use it for 30 days, give it the "third degree" and send it back if it isn't all we claim.

Peter Bros. Mfg. Company

135 Railroad Ave. Algonquin, Illinois

Messrs. A. A. Jones & Shipman of Leicester, England, carry a complete line of these chucks.

Drill Chucks
Lathe Chucks
Centering Chucks
Portable Face Plate Jaws

Iron Bodies Steel Bodies

Many styles and sizes
All designed for hard and exacting Service

Catalog Free

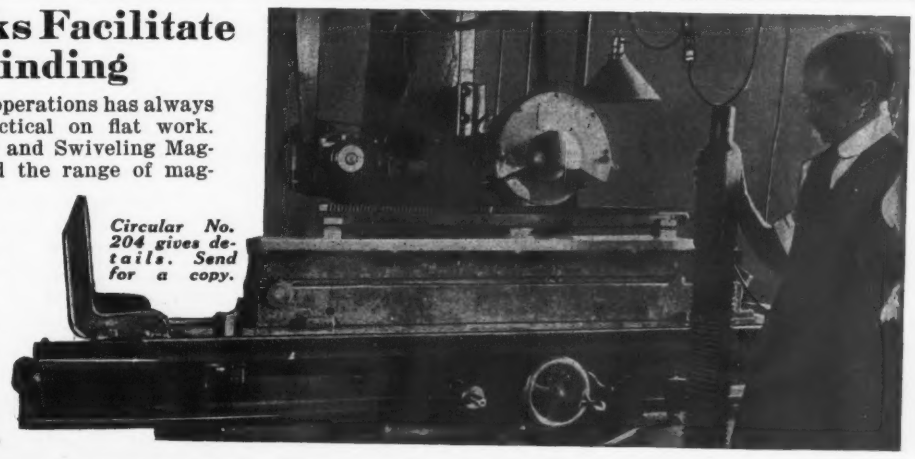
THE CUSHMAN CHUCK CO.

Hartford, Conn., U. S. A.

D & W Taper Chucks Facilitate Clearance Grinding

Magnetic chucking for grinding operations has always been considered thoroughly practical on flat work. The advent of the D & W Taper and Swiveling Magnetic Chuck has greatly widened the range of magnetic chucks, as it permits such work as knife blades and cutting tools of all kinds to be ground at any angle and with just the right clearance. The photograph shows an actual illustration of clearance grinding on broaches at the factory of the J. N. Lapointe Co., New London, Conn.

Circular No. 204 gives details. Send for a copy.



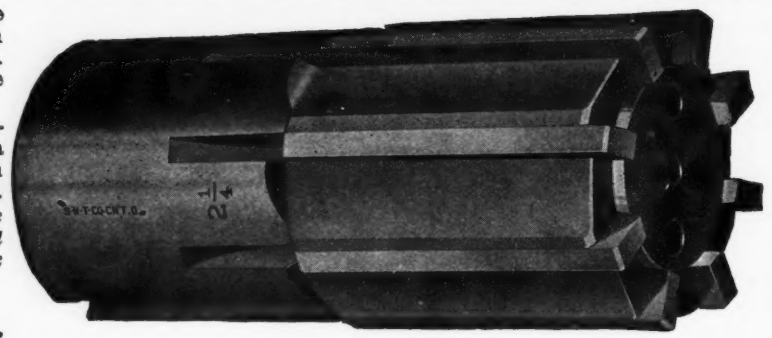
D & W FUSE CO., Providence, R. I.

THE ACME RIGID H. S. EXPANDING BLADE SHELL REAMERS

You can spend two hours of a tool-maker's time underlaying blades and grinding reamers down to size for every few hours' use if you want to. With the Acme reamers ninety per cent of the time thus wasted is saved.

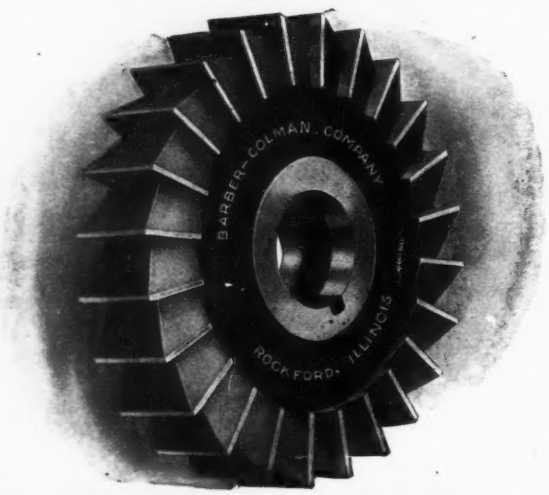
With the Acme reamers you can get an expansion as fine as .0005 in a few seconds, and a maximum expansion of the blades of ⅛". When the blades are worn out they can be renewed.

Try an Acme against any reamer you have ever used and see the great difference in general efficiency and lower cost of maintenance. Write for an Acme bulletin today.



The Schellenbach-Hunt Tool Co., Cincinnati, O.

FOREIGN AGENTS: C. W. Burton, Griffiths & Co., London, England. Markt & Co., 193 West St., New York; Germany and Italy. New York Export and Import Co., 133-137 Front St., New York; China, Japan and Australia. Williams & Wilson, Montreal, Canada. J. S. Cock, Christiania, Norway.



B-C Milling Cutters

We don't depend upon our reputation to sell our cutters—every last tool is turned out with as much care as though our entire future business depended upon that particular cutter being just right. Such a policy insures you *always getting* the best in design, material and workmanship.

The B-C line includes Hobs, Tooth-cutters, Slitting-saws, End Mills, etc. Catalogue?

BARBER-COLMAN COMPANY
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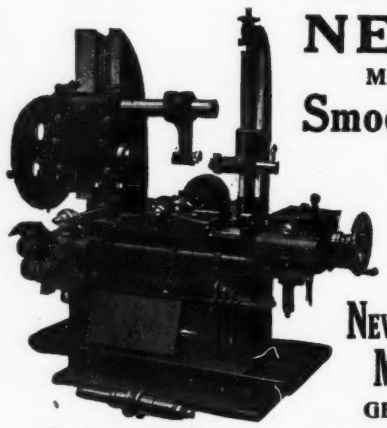
Guaranteed Forgings for all Machine Parts

Wyman-Gordon Company
Worcester, Mass.
Cleveland, Ohio



NEWARK
MACHINES FOR
Smooth Running Gears

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NEWARK GEAR CUTTING MACHINE COMPANY
GEAR SPECIALISTS
69 Prospect St., Newark, N. J.

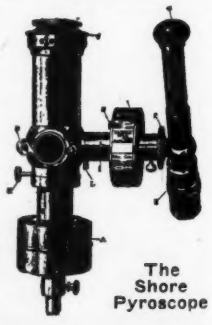
Our No. 3—36" Spur Gear Cutting Machine

Testing a die for Hardness (Scleroscope on Swing Arm)

Have You a Scleroscope to Test Your Metals?

For Softness, Hardness or Strength

Can be operated by non-technical help. The majority of manufacturers are thus ordering their material to specification, as to quality and fitness, meaning that the minority who have not a scleroscope to inspect their material may have to accept the discard of their more up-to-date competitors. It shows if you are getting what you pay for out of your tool steels. Send for our 80-page booklet. Free.



The Shore Pyroscope

THE PYROSCOPE OPTICAL PYROMETER

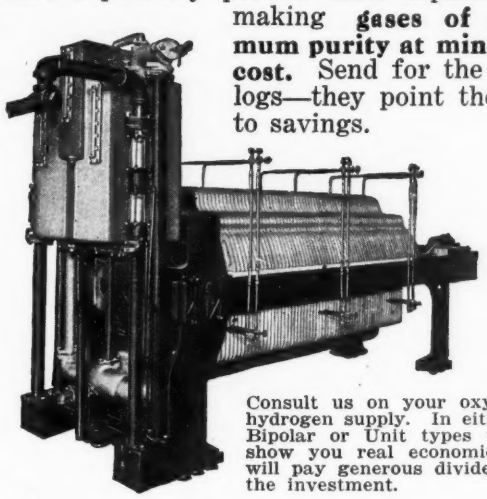
If your heat troubles are still unsolved, investigate the pyroscope, the one common-sense instrument that makes straight for results without fuss. Extreme simplicity—constancy—always ready. Pamphlet on request.

SHORE INSTRUMENT & MFG. CO., Inc., 555-557 W. 22nd St., New York

FOREIGN AGENTS: Coats Mch. Tool Co., London, England. Schuchardt & Schutte, Tokyo, Japan. Iznosskoff, Suckau & Co., Petrograd, Russia. Aux Forges de Vulcain, Paris, France. R. S. Stokvis & Zonen, Ltd., Belgium and Holland.

More Cutting and Welding Per Cubic Foot of Gas

Of course, impure oxygen and hydrogen will do your work—after a fashion. But it is to your interest to know that high-purity I.O.C. oxygen and hydrogen will do **more work** per unit of gas. And they will cost you less, too — for I.O.C. Oxyhydrogen Generators have repeatedly proved their capacity for making **gases of maximum purity at minimum cost.** Send for the Catalogs—they point the way to savings.



Consult us on your oxygen or hydrogen supply. In either our Bipolar or Unit types we can show you real economies that will pay generous dividends on the investment.

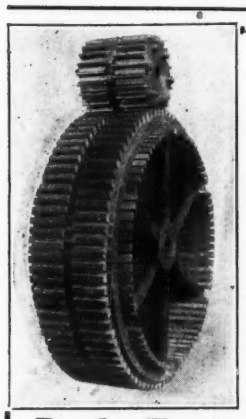
International Oxygen Company
115 Broadway New York
London: Arthur Lyon and Wrench, Ltd., Caxton House, S. W.

RAWHIDE PEERLESS PINIONS

retain their efficiency, elasticity and durability long after many others have given up under conditions of modern high speed production.

Peerless Rawhide Pinions owe their superiority to the care taken in manufacture—from the selection of hides to the cutting of the finished blank. They mesh perfectly with metal gears, are noiseless in operation and save power. Investigate Peerless Rawhide Gears now. We also make cut metal gears for all purposes.

THE HORSBURGH & SCOTT CO.
CLEVELAND OHIO, U. S. A.



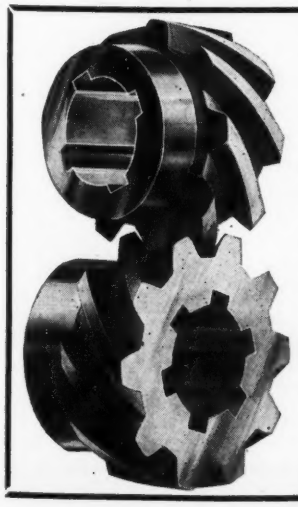
Equipped to Handle All Kinds of

Special Machine Work

We make the unusual machinery that other shops are not now equipped to handle.

Nothing too large for our equipment.

Poole Engineering & Machine Co.
BALTIMORE, MD., U. S. A.
New York Office, 50 Church Street



Day and Night SERVICE

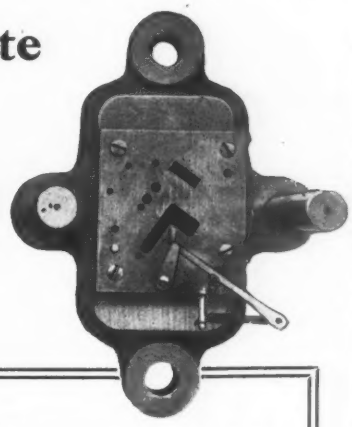
Suppose some machine is tied up for the lack of a special gear. Do you *know where* to get it—quick? Telegraph the "Day and Night" shop.

Any type of gear. Any size. Any quantity.

Send blueprints for estimates

ALBAUGH-DOVER CO.
Marshall Boulevard and 21st Street
Chicago Illinois

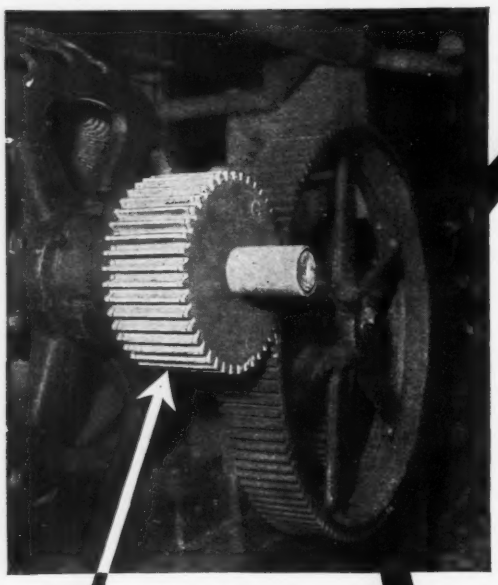
A Delicate Die that has Punched 60,000 Pieces



THE shift lever combs used in Corona typewriters are clean, accurate punchings from 0.050″ steel. We completed and shipped the die which punches these parts in November, 1911. It has been in use ever since, has punched over 60,000 pieces and has been ground twice.

We can make dies and tools for you just as good as we make them for the Corona Typewriter people. May we?

TAYLOR-SHANTZ COMPANY
ROCHESTER NEW YORK



This is a Micarta-D Pinion

Westinghouse

Bakelite

Micarta-D Gears

have all the good qualities of steel, none of the bad qualities of other non-metallic gears.

They Are Noiseless

Waterproof—Oil proof—Proof against acid fumes

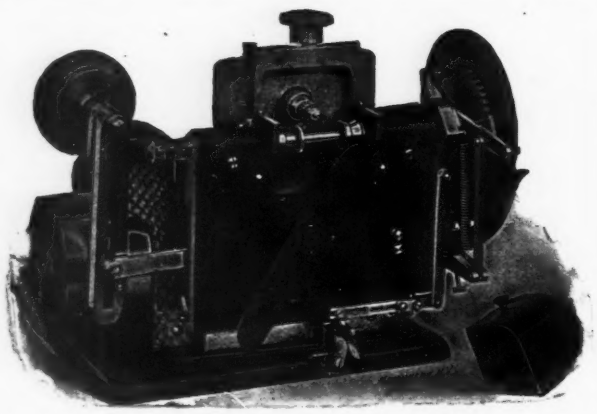
They are self-supporting; not held under compression. They can be stocked indefinitely without deterioration. They are the only non-metallic gears that will not warp, shrink or swell.

They can be advantageously substituted for steel, bronze, rawhide or other non-metallic materials used for gearing.

Westinghouse Electric & Manufacturing Co.
East Pittsburgh, Pa.
Sales Offices in All Large American Cities

W WESTINGHOUSE ELECTRIC

Westinghouse



The Waltham Gear Cutting Machine

A serviceable machine for cutting small brass and steel gears and fine pitch pinions. The Waltham is entirely correct, capable of fine adjustment and entirely automatic in operation. Cutter is lifted from the work after cut is taken and indexing starts on return stroke without loss of time. All working parts protected from chips. 4 inch capacity.

Write for full description.

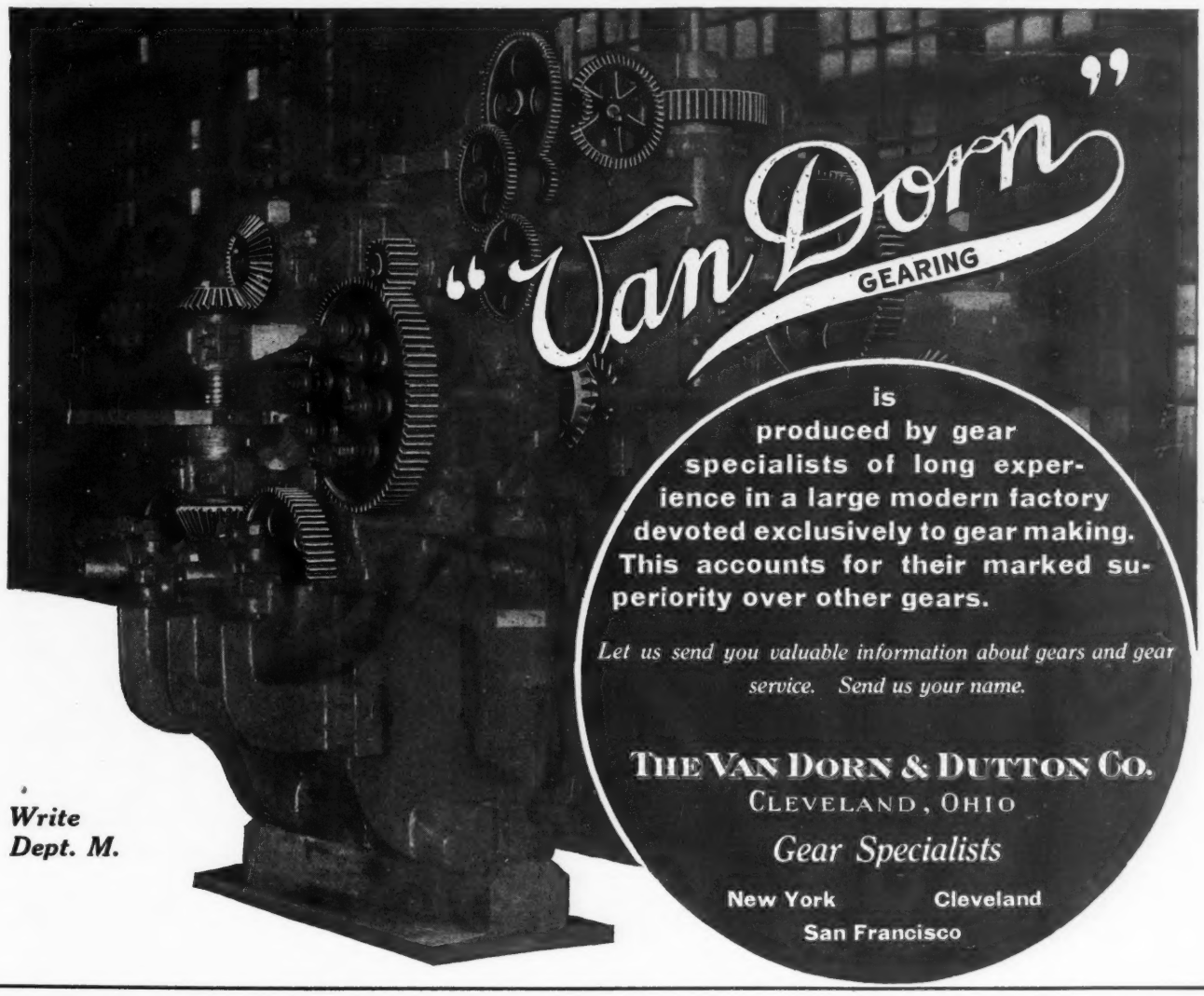
Waltham Machine Works
Makers of Precision Bench Lathes and Machinery
NEWTON STREET, WALTHAM, MASS., U. S. A.

FORGED GEAR BLANKS

¶ The way you want them—when you want them. Gear blanks of open-hearth steel of any carbon, nickel, chrome-nickel, chrome vanadium, etc., furnished in any quantities for prompt delivery. Our product is guaranteed to follow specifications to the letter—our service is one that can be depended upon in the emergency as well as for ordinary demands.

Try us on your next order.

The
MACHINERY FORGING CO.
Hamilton Ave. and Marquette St. CLEVELAND, OHIO



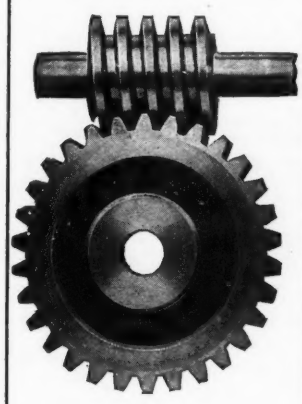
"Van Dorn" GEARING

is produced by gear specialists of long experience in a large modern factory devoted exclusively to gear making. This accounts for their marked superiority over other gears.

Let us send you valuable information about gears and gear service. Send us your name.

THE VAN DORN & DUTTON CO.
CLEVELAND, OHIO
Gear Specialists
New York Cleveland
San Francisco

Write Dept. M.



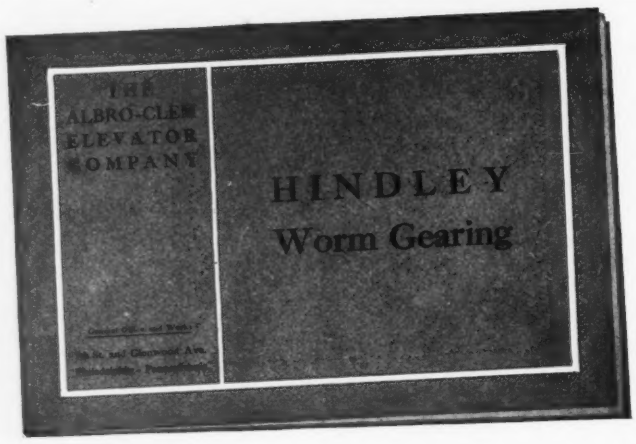
IMMEDIATE DELIVERY

Nothing eats into your surplus so quickly as idle wheels. A few small gears may not seem much in themselves, but the operation of your entire plant may depend upon them. No use worrying over breakdowns, with their expense and inconvenience, when Boston Stock Gears provide the remedy.

We'll carry your gear stock for you, giving you the added advantages of **interchangeable gears, immediate deliveries, lower prices,** and less tied-up capital. **Our stock is complete,** our facilities practically unlimited, and material we use only the best. Begin *now* to give yourself the benefit of Boston Stock Gears. Send for catalog.

NOTE! WE ARE IN A POSITION TO CUT YOUR BLANKS PROMPTLY

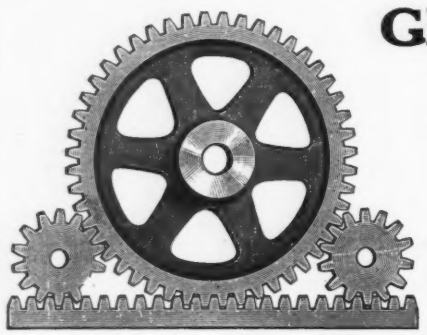
BOSTON GEAR WORKS
NORFOLK DOWNS (QUINCY), MASS.



Why?

Why is Hindley Worm Gearing more efficient? Why is its life greater? How does its cost compare? Why should *you* use it? These are questions we have endeavored to answer in this catalogue. If you are interested—and you should be—we'll send a copy. *Post-card request is sufficient.*

The Albro-Clem Elevator Co.
701 Glenwood Ave. Philadelphia, Pa.



GRANT GEARS

Iron Cut Gears, Brass Cut Gears and Cast Gears in stock. We also furnish gears to order, all sizes from ¾ inch to 6 feet in diameter, any face. Deliveries prompt, workmanship the best and prices reasonable.

May we send our catalogue and price list?

GRANT GEAR WORKS
INCORPORATED
151 Pearl Street, BOSTON, MASS.

Gears and Gear Cutting
We Guarantee Satisfaction
RODNEY DAVIS, Philadelphia

BEVEL GEAR GENERATORS

BEVEL GEARS
CUT THEORETICALLY CORRECT

Special facilities for cutting Worm, Spiral, Miter, Internal and Elliptical Gear Wheels.

THE BILGRAM MACHINE WORKS 1231 SPRING GARDEN ST. PHILADELPHIA, PA.

METAL SPINNINGS

We spin all kinds of metal and specialize in steel.

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The Old Reliable Columbia Caliper

6" No. 5 has 1¾ hardened jaws, reads in 16ths, 64ths and 128ths with vernier. Until further notice $2.50—sent prepaid. Caliper Booklet shows many styles.

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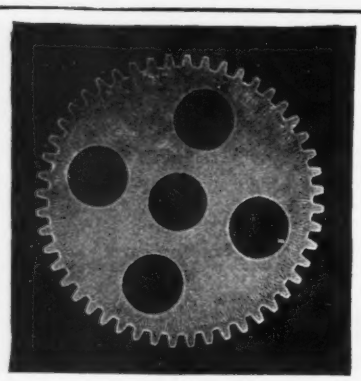
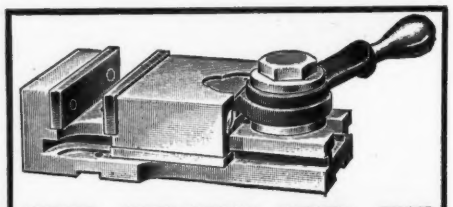


GENERATED
in our
Gear Cutting Department
(Cut is full size)

LET US QUOTE YOU

MEISSELBACH-CATUCCI MFG. COMPANY
27 CONGRESS STREET NEWARK, N. J.



QUICK OPERATING LEVER VISE

Of excellent design and thoroughly well made.
You can rely on it for satisfactory service.
A trial will convince you.
We shall be glad to send full details.

The Carter & Hakes Company
Sterling Place, WINSTED, CONN.

CROFOOT GEARS

Made in our modern fire-proof factory completely equipped for the production of high-grade gears
Satisfactory prices—prompt delivery.

TRY US FOR SERVICE

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American and foreign patents secured. Searches made to determine patentability, validity and infringement.
Handbook for inventors sent upon request.

McGill Building WASHINGTON, D. C.

"Hickory Dickory Dock, the mouse ran up the clock—
The clock struck one, the mouse ran down—"

and the clock never skipped a tick. The gears in that clock were made like "Philadelphia's," and nothing short of old age or a complete smash could put them out of business.

PHILADELPHIA GEARS

are the service gears of the machinery field and the reserve supply for gear users who want gears that can be depended upon to travel fast and be O. K. when they arrive. We have a practically inexhaustible stock of standard gears ready to ship on demand, and a gear-to-order department that holds the record for speed on gears for special requirements.

There's economy in using Philadelphia Gears. We can show you on a trial order.

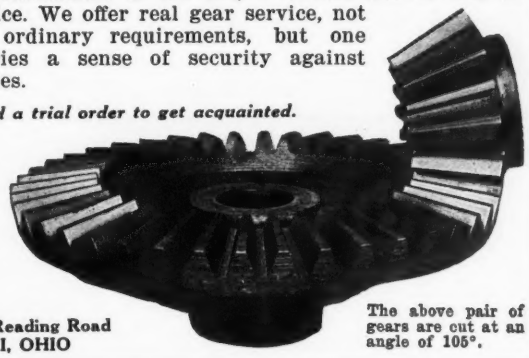
PHILADELPHIA GEAR WORKS
1120 VINE STREET **PHILADELPHIA, PA.**

Mechanical Adaptations of Mother Goose Myths

Gears You Can Get When You Want Them

We specialize in gears of every description; gears that follow specifications to the dot, and that can be had on short notice. We offer real gear service, not only for ordinary requirements, but one that carries a sense of security against emergencies.

Send a trial order to get acquainted.



The above pair of gears are cut at an angle of 105°.

The Cincinnati Gear Company
1827-1833 Reading Road
CINCINNATI, OHIO

Fawcus Machine Company
PITTSBURGH, PA.

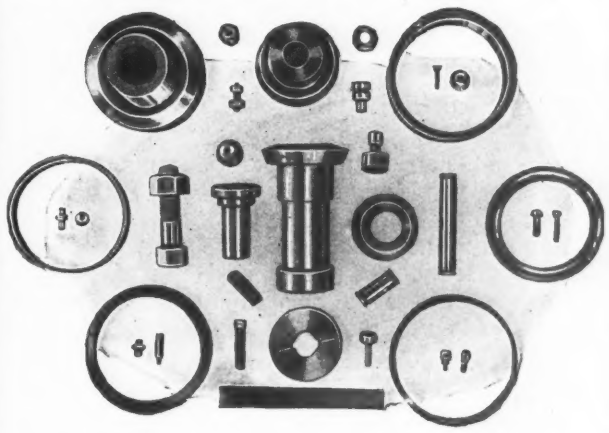
Gears of all descriptions to 24 feet diameter. Heavy machinery designed and furnished for all purposes.

WORKS: FORD CITY AND PITTSBURGH, PA.
MAIN OFFICE: PITTSBURGH, PA.

the Simonds Mfg. Company. Pittsburgh Pa. U.S.A.

Cut Gears, Racks, Worms, Worm Gears, Special Machinery, Motor Gears *and* Pinions

AUTOMATIC SCREW MACHINE PRODUCTS



We are equipped to make everything in this line from small dimensions to parts up to 5½" diameter. Our prices are as low as quality permits. The fact that we have been many years in business and never lost a customer is a guarantee that we can do good work for you.

We are also prepared to furnish high-grade gears—almost any gear you can call for—in any quantity. Write us your requirements.

MEISEL PRESS MFG. CO.
948 DORCHESTER AVE. **BOSTON, MASS.**

Clutch Gears. A kind of work that is easy for us.

"Any Old Gear" WON'T DO Everywhere, but New Process Gears and Pinions WILL.

You get more than mere material and machine work when you buy New Process Gears and Pinions. You get correct tooth design, right machining methods, judicious selection of metal and the careful finish essential to permanently satisfactory service.

One order would prove to you that New Process Gears and Pinions are reasonable in price and genuinely good.

Send your prints or specifications for figures.

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YOU CAN'T PUT YOUR GEAR WORK INTO BETTER HANDS

NEW PROCESS GEAR CORPORATION

SYRACUSE, N. Y.

91

Foote Rawhide Pinions are Economical Mufflers of Noisy Drives

They are made from the best grade hides that can be bought, by a special process which insures finished pinions that are accurate, long lived, and capable of carrying their part of any load for which a quiet drive is desired. Specially adapted for high speeds.

Foote is equipped to furnish all kinds of gears. Materials and workmanship guaranteed. Send your next order to Foote.

Gear Problems "G. X." on request.

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SAFE — SILENT — EFFICIENT

From a Magneto To a Dreadnought

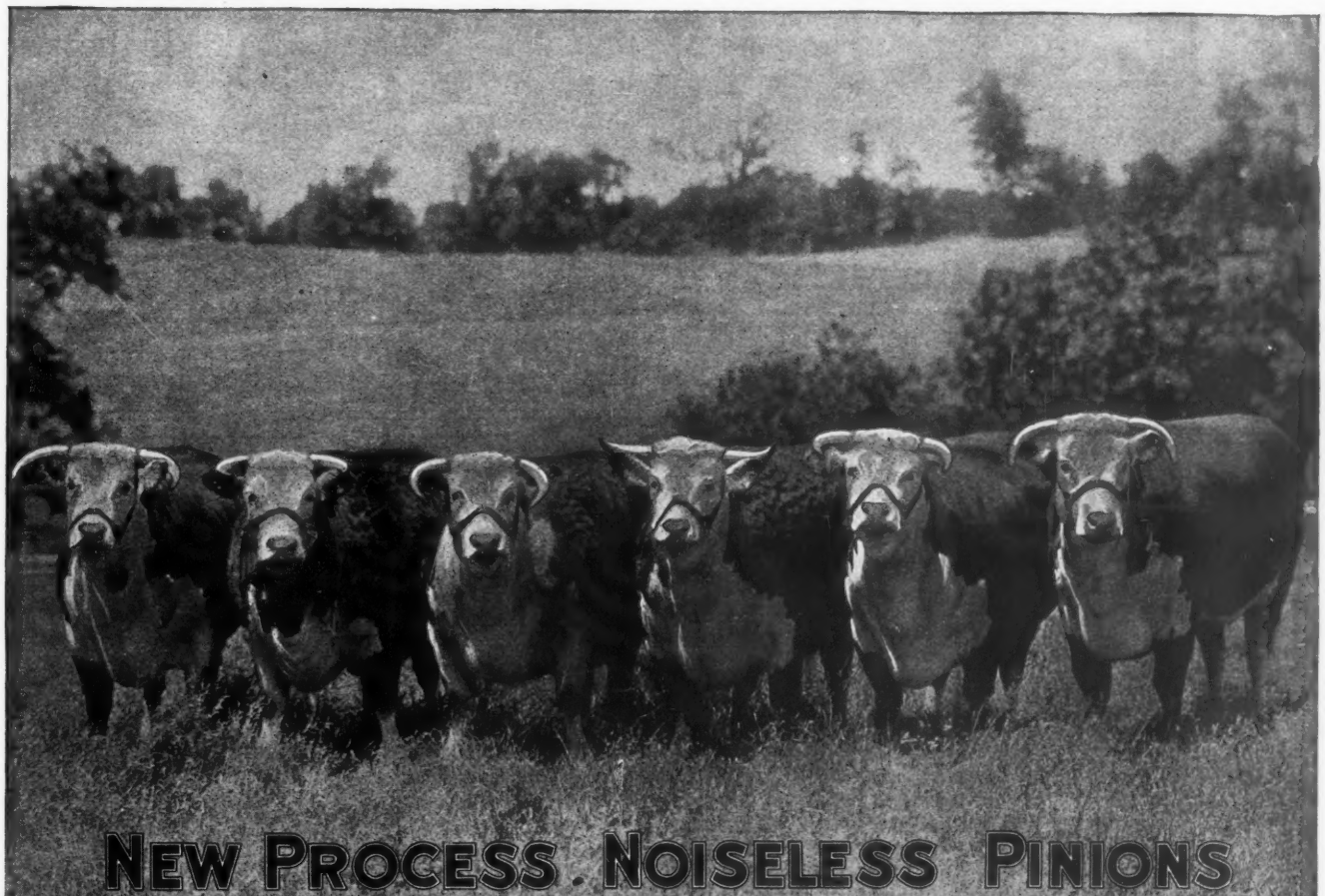
A far cry indeed, but it adequately expresses the range of requirements we can meet with good gears. We make gears for magneto drives—we make steering gears for battleships.

Hindley Gears

are ideal for many purposes. Uniform accuracy, efficient driving qualities and durability are the features responsible for their success. Among the many satisfied users are engineers and manufacturers whose demands are hard to meet because their standards are so high. Hindley Gears made good. Ask those men.

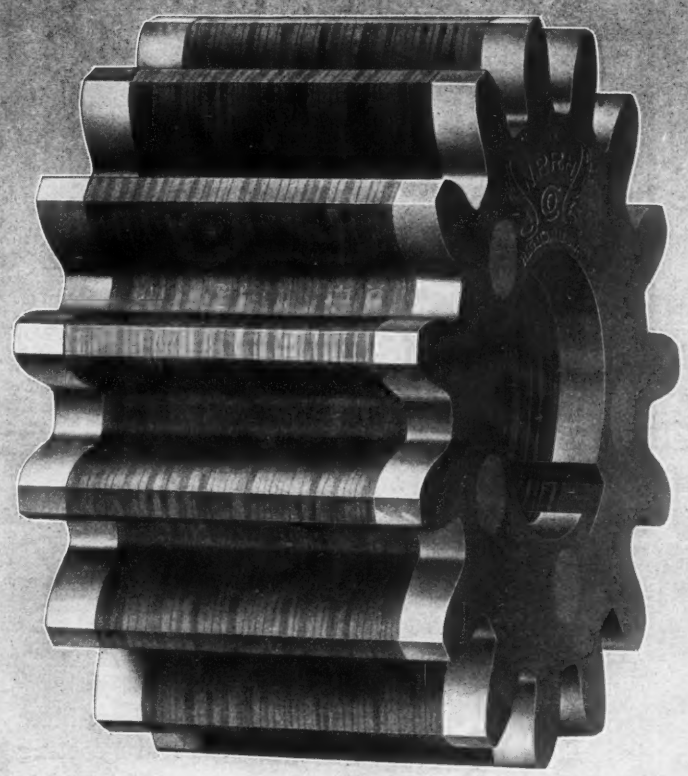
HINDLEY GEAR COMPANY

1105 FRANKFORD AVE. PHILADELPHIA, PA.



NEW PROCESS . NOISELESS PINIONS

PRIZE WINNERS FROM START TO FINISH



SELECTED hide stock specially cured for gear requirements by an exclusive process; machined in a gear plant that knows no equal.

"Do it noiselessly"
with New Process Pinions

and your good judgment will be rewarded by bigger, better production, lessened wear and tear on machine parts, and better conditions for your men.

Send for *and read* our booklet "Noiseless Gear Driving."

NEW PROCESS GEAR CORPORATION
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¶ We make a specialty of the highest grade Drop Forgings. Our exceptional capacity and equipment insure accurate forgings and prompt delivery. Send us models or blueprints and permit us to estimate on your requirements.

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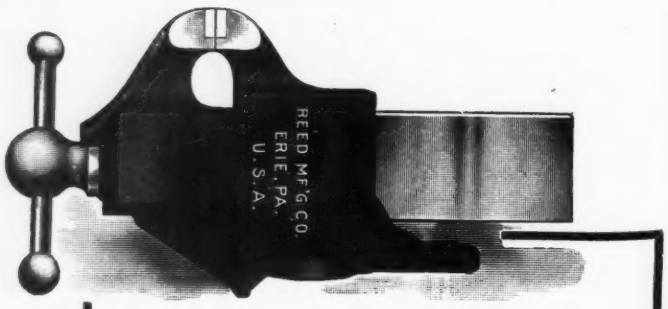
Whitman & Barnes Manufacturing Co.
Established 1854
120th Street CHICAGO, ILL.



A "Reed" on Your Bench

Don't be satisfied to buy "any old vise"—demand a "Reed" and get 100 per cent value for every dollar spent. Reed Vises are as unbreakable as a vise can be made. One on your work-bench will insure the best vise service possible.

Reed Vises hold work rigidly, do not get out of order, and stand the strains of severe service. Catalogue H is a reference book for use when buying vises. May we mail you a copy today?

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Erie, Pa., U. S. A.

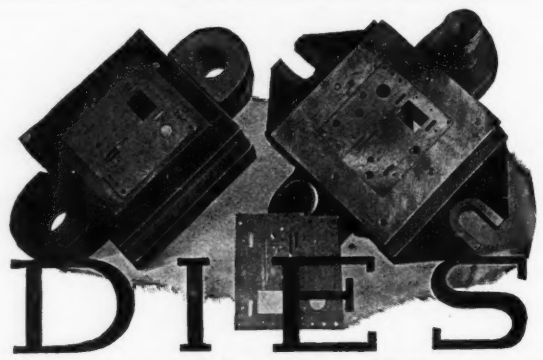
DIES *that are* Made the Way You Want Them

We manufacture high-grade punches and dies of various kinds for use in connection with sheet metal work and described as follows:

Blanking, Piercing, Forming, Trimming, Drawing, and Sub-press work.

We pay particular attention to see that the dies are made according to the desires of our customers. Write us.

The Columbus Die, Tool & Machine Co.
COLUMBUS, OHIO, U. S. A.



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It pays to use Nelson Dies. Highest grade workmanship. Prices right. Consult us.

NELSON TOOL COMPANY, Inc.
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Nothing to Do but Drive

You are not put to the trouble of filing and fitting when you use our Finished Machine Key. We finish them *complete*—all ready to drive, and you can always depend upon accurate machining and true size. We have special facilities for making Machine Keys any length, width, depth, style or taper. If your keys are costing too much—get our prices.

Our specialties include: Machine Racks, Cold Drawn Shafting, Screw Stock, Flats, Squares, Hexagons and Special Shapes. Send for interesting Catalog.

STANDARD GAUGE STEEL COMPANY, Beaver Falls, Pa., U. S. A.

BRANCH OFFICES: Chicago, Ill., and Philadelphia, Pa. Pacific Tool and Supply Co., San Francisco, Cal. Dilworth Lockwood & Co., New York. R. B. Ridgley, Detroit, Mich. A. L. Maeder Co., Portland, Ore. Hall & Pickles, 64 Port St., Manchester, England.

When You Need Tools Bear in Mind this

TRADE MARK

After you have once used Billings & Spencer tools no other reminder is necessary.

The satisfaction and good feeling created in the mind of the mechanic who uses Billings & Spencer tools are constant reminders, because he always associates

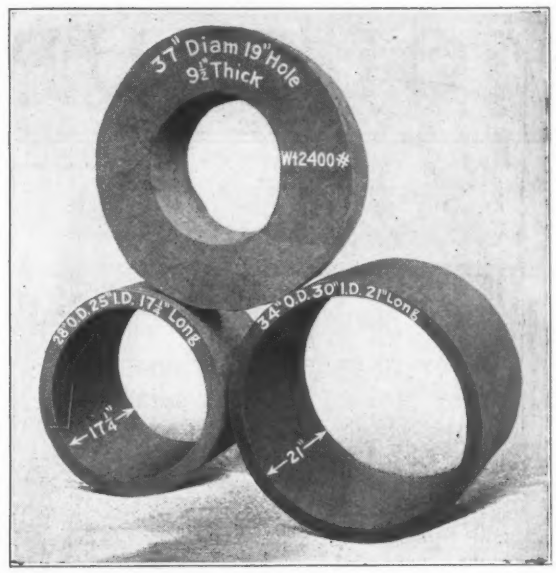
BILLINGS & SPENCER

with his satisfied state of mind. Billings & Spencer tools are tools built by mechanics for mechanics.

As a mechanic you know the difference between good tools and poor tools, and all that we ask of you is to try the tools marked with the above trade mark.

You will find them at all dealers of good standing.

The Billings & Spencer Co.
HARTFORD, CONNECTICUT

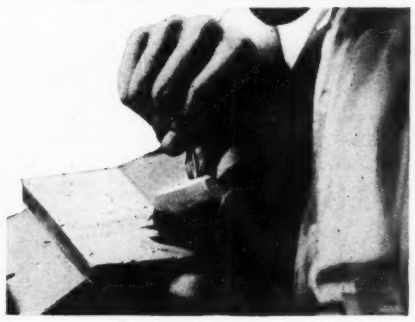


What Dyson can Do for You

If you need high-grade forgings of any kind of steel, for any purpose, Dyson can supply them; if you want forgings rough-machined and heat-treated, Dyson can do the work; if you desire information on the adaptability of metals for work under consideration, Dyson can answer that call too.

Dyson makes guaranteed forgings up to five tons—and heat-treats them properly. Let us figure on your requirements.

JOSEPH DYSON & SONS, Cleveland, Ohio



Workmen Who Serve Matthews Customers

The trained hands and eyes of skilled workmen guide the cutting and tempering of Matthews Steel Lettering Dies and Stamps.

Write for our catalogue.

Established 1850

Jas. H. Matthews & Company, Pittsburgh, Pa.

DIE-CASTINGS

Are Better Than Machined Products

If—Free from Flaws,
True to Specifications,
Cast of Dependable Alloys.

Years of experience have taught us how to meet these conditions.

Quantity of production permits the substitution of

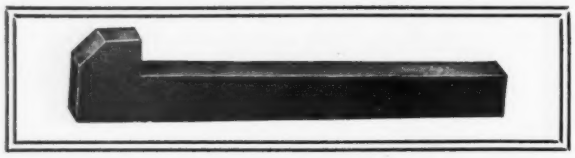
VAN WAGNER

die-cast parts for machined parts at a saving.

Send Blue-Prints, Samples or Specifications for our estimates.
Prompt Quotations will follow.

E. B. Van Wagner Mfg. Company
SYRACUSE, NEW YORK

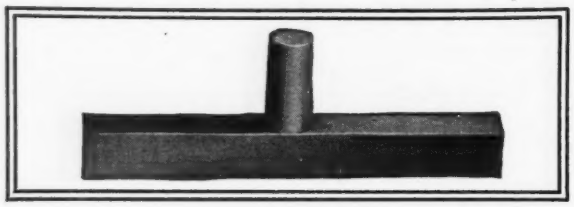
MOLTRUP



The name is your guarantee of highest quality

Over 20 years' experience in Key making at your service. Gib Head—Plain Taper—Round End Feathers—Special Keys for every manufacturing purpose.

May we make yours?



Moltrup Steel Products Co.

BEAVER FALLS, PA.

Agencies: Allison & Co., Chester, Pa.; Geo. W. House, Detroit, Mich. 1061 Continental & Commercial Bank Bldg., Chicago, Ill.

1816 *One Century in Business* 1916

FRASSE-ELECTRIC STEEL

TOOL AND SPRING STEEL
NICKEL, CHROME SILICO MANGANESE
CHROME NICKEL, SILICO MANGANESE

NEW FRASSE ELECTRIC STEEL WORKS, Hartford, Ct.
In Operation September 1st.

PETER A. FRASSE & CO., Inc.

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417-421 CANAL STREET, NEW YORK

PHILADELPHIA BUFFALO HARTFORD

WEDELL & BOERS
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TOOL CARE REQUIRES A TOOL CASE

The ideal tool case for the practical mechanic is the W. & B. It is compact and strong, has stationary tray for heavy tools, and drawers are fitted in lengths and depths to take tools of all sizes. W. & B. Cases are covered with Seal Grain Cowhide or Karatol, as preferred, and are handsomely finished.

Write for booklet and prices.

Lower Your Tapping Costs with a

Sizes 1" to 12". Circular on request.

VICTOR COLLAPSIBLE TAP

Save the time now *wasted* in backing out a solid tap. Even if it is only a few seconds each time, those seconds total a substantial amount in a week's work. Victor Taps are strong, durable and simple. No complicated parts to get out of order. Body of machine steel, chasers high-speed steel. Set screw adjustment from front maintains setting. Automatic trip prevents spoiled work. Ideal for tapping shells.

VICTOR TOOL COMPANY

WAYNESBORO, PA., U. S. A.

They're Good Tools

Bay State Taps and Dies

meet every requirement for clean cut, accurate threads and cost saving service. They are made from best grade steel, hardened according to the Bay State special process, tested before being put in stock and guaranteed to be free from imperfections.

Bay State Taps and Dies cut the cost of high-grade threading to low figures. Why not give them a trial? Taps, Dies, Screw Plates, etc.

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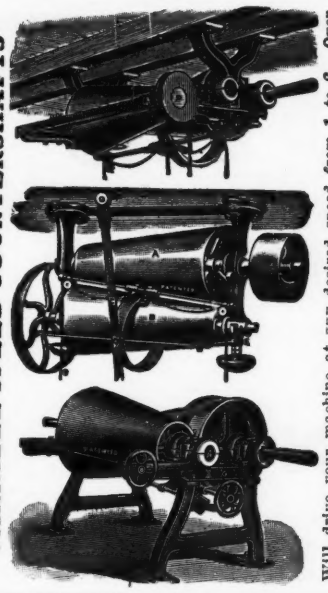
Bay State Tap & Die Co.

MANSFIELD MASS., U. S. A.

Representatives for England: Geo. W. Goodchild & Macnab, 56-58 Eagle St., Southampton Row, London, W. C. Representatives for Scandinavia: Wilh. Sonesson & Co., Ltd., Malmo, Sweden.

Evans Friction Cone Pulleys
VARIABLE SPEED COUNTERSHAFTS



Will drive your machine at any desired speed from 1 to 6. Over ten thousand sets in operation in this country and Europe. Send for Catalog.
G. F. Evans, Newton Center, Mass.
Foreign Agents: A. Warden & Co., 48 Shepherdess Walk, London, E. C.

Power

Is your Engine or Motor developing its full power? You don't know unless you know the speed you are attaining.

Why not determine this by taking readings occasionally with the

Veeder
Speed Counter

PRICE $3.00 EACH
FULLY GUARANTEED

Circular on request.

Straight Reading, Non-Magnetic, Ball Bearing, Clutch Mechanism which insures accurate readings.

The Veeder Manufacturing Co.
39 Sargeant St., HARTFORD, CONN.
Makers of
Cyclometers, Odometers, Tachometers, Tachodometers, Counters and Die Castings.

Perfectly Safe at Highest Speeds

Thousands of Gilbert Wood Split Pulleys are withstanding shocks, sudden changes of load, and running at speeds which would ruin the ordinary wood pulley, and even shatter heavy iron pulleys. The greater strength of Gilbert Pulleys is due to superior design and the hard, close grained maple wood used in their construction.

GILBERT WOOD SPLIT PULLEYS

are built up in sections, arranged to offer the maximum resistance to compression, but still allow sufficient spring to offset the effect of sudden shocks. The polished surface of the pulley face assures perfect belt contact, safety at highest speeds, and permits the pulley to transmit from 40 to 50 per cent more power than would be possible with an iron rim. Light in weight and guaranteed correct in balance and trueness of running.

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SALES AGENCIES IN ALL THE PRINCIPAL CITIES IN THE WORLD
New York Branch, 88 Warren Street Chicago Branch, 105-109 So. Jefferson Street
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Drawing Materials, Mathematical and Surveying Instruments, Measuring Tapes.

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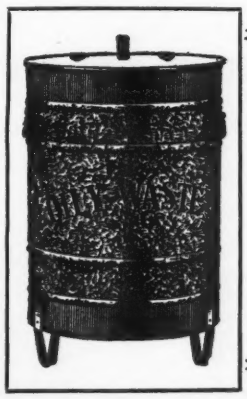
General Office and Factories:
HOBOKEN, N. J.
Chicago St. Louis San Francisco Montreal



Two Delphos Shop Aids

The Delphos Waste Can, with its air-tight, self-closing cover, is first aid to fire prevention; the Delphos Non-overflow Factory Dispenser for filling small oilers prevents waste and contributes toward shop orderliness. Both are strong and serviceable—real necessities in every up-to-date plant. *Catalog?*

DELPHOS MFG. COMPANY
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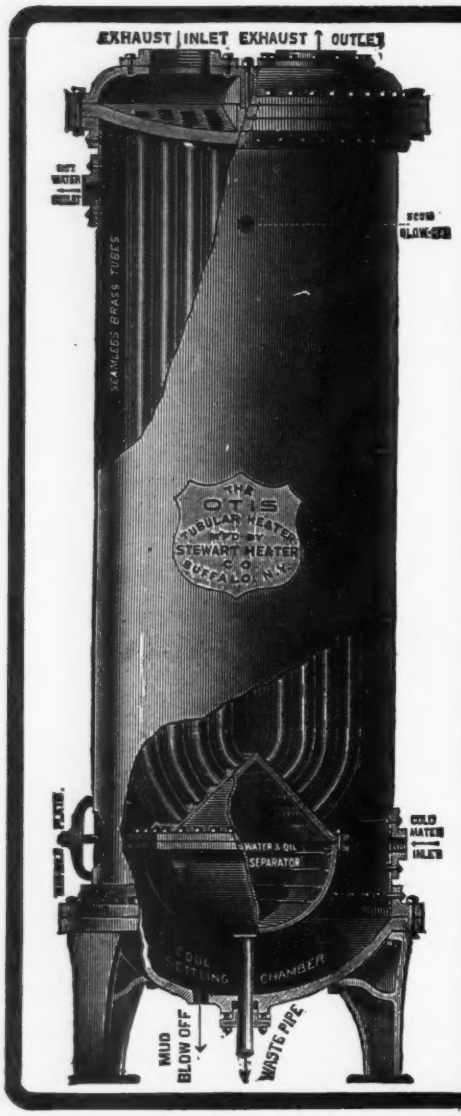
THE JOHNSON FRICTION CLUTCH

WRITE FOR CATALOG "A."
Send for Our Booklet "CLUTCHES AS APPLIED IN MACHINE BUILDING"

THE CARLYLE JOHNSON MACHINE CO. MANCHESTER CONN.



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Tubular Feed Water Heater, Oil Separator and Purifier

is not an experiment, but a tried and trusted appliance that the makers are not afraid to

GUARANTEE

To heat the feed water to the *boiling point* (210 to 212 degrees) with the exhaust steam without causing any back pressure; *also to extract the oil from the exhaust,* so that the exhaust steam, after being passed through the heater, can be used for heating purposes, and the water of condensation for the heating system be returned to the boiler without the *additional expense* of an *eliminator.*

We are so sure of the OTIS that we agree to pay all costs of a trial—freight, cartage, piping, etc.—if it fails to do all we claim for it.

Catalogue and Prices at your Service

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Screw Machine Products
OF ALL KINDS

We have recently equipped with new machinery for making all kinds of screw products. Send in blue prints or samples for prices. Deliveries will be prompt and quality right up to the top notch, for which our reputation is well known. *Prices will please you, too.*

Toledo Screw & Stamping Co.
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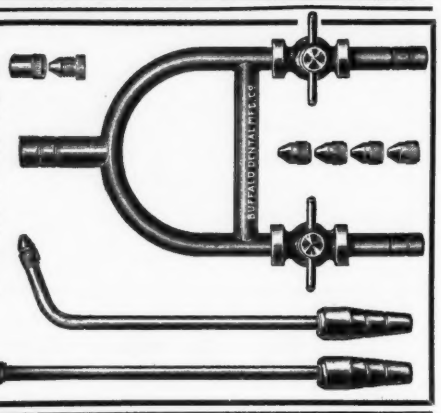
FOR LEAD BURNING

Our No. 28 Oxy-Hydrogen Lead Burner is most complete. Equipped with taps that are ground to a seat, making them easy to manipulate—safety gauzes in the throat of the yoke to prevent accident by a flashing back of flame—a series of jet tips with varying sized orifices, and a wind shield adjustment to permit its use in draughty places. A straight and curved burner shaft that will meet every possible condition. Price, complete with 5 feet rubber connecting tubing, $7.00. Ask for catalog "B. M.," illustrating and describing this and all our chemical laboratory apparatus.



BUFFALO DENTAL MANUFACTURING CO.
BUFFALO, N. Y., U. S. A.

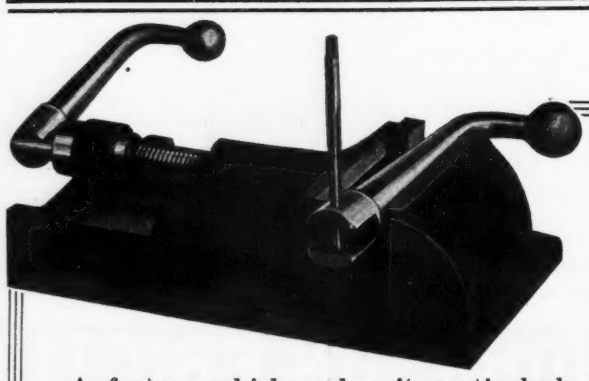
A. G. BUTLER, Inc.

PATTERN LETTERS

For Iron and Brass Castings. Various styles and sizes. For Machines, Bridges, Tablets, etc.

Leather Fillet. All sizes in stock.

Postal Telegraph Bldg., 253 Broadway, New York



The MOHN VISE Can Be Used At Any Angle

A feature which makes it particularly handy in drilling and milling at angles. Quickly adjusted. Grips with an ungivable hold. Strong and powerful. Unique handle which can be turned in, out of the way, once vise is adjusted.

Three sizes. Circular and prices on request.

W. D. MOHN & CO., Reading, Pa.

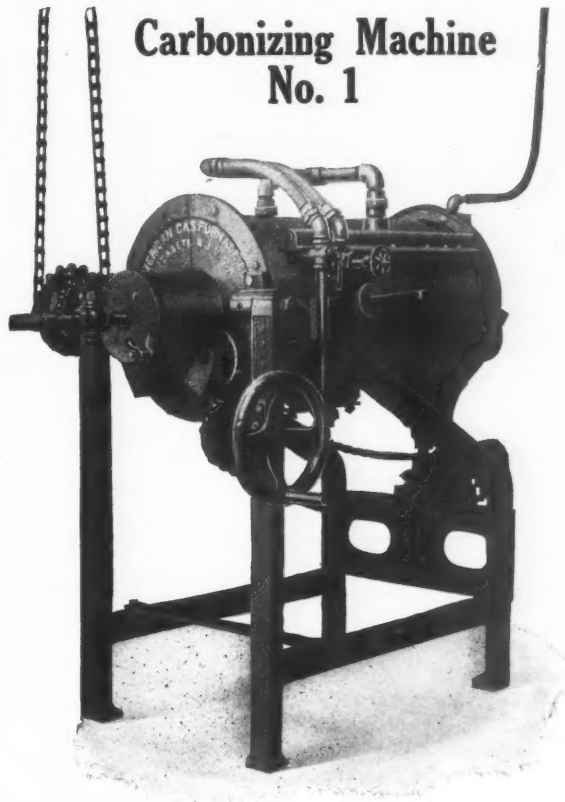
Keep Case Hardening Costs Uniform and Low

This **"American"** Carbonizing Machine will enable you to do it. Built to take work up to 6″ diameter and 20″ long, it occupies only 42″ x 69″ of floor space. It uses gas with marked economy, meets exacting demands for service, and produces uniformly high-grade work at low cost.

This is but one of the many furnaces and heating machines in the **"American"** line. All are built to meet the demands of manufacturers who require heat-treating equipment of unusual exactness, control and economy.

Special Book on "Case Hardening with Gas" and Catalogue of the full line of American Furnaces on request.

Carbonizing Machine No. 1



AMERICAN GAS FURNACE CO., 24 John St., New York

ENGINEERS AND MANUFACTURERS

One Product Only— FORGINGS

We concentrate all our efforts on making just one thing—Forgings. And following that policy strictly, we are enabled to turn out work that, for reliability and wide range of service, is unsurpassed.

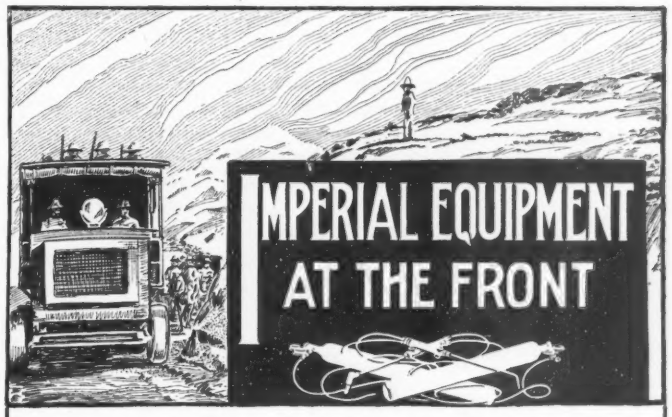
We carry a large stock of material, our shop facilities are unequaled, workmen experts in their line, and last—and all-important—*our methods are right.*

Prompt deliveries on all orders, large or small. Send blueprints or drawings for quotation.

THE MACHINERY FORGING CO.

Hamilton Ave. and Marquette St.

CLEVELAND OHIO, U. S. A.



Somewhere in Mexico

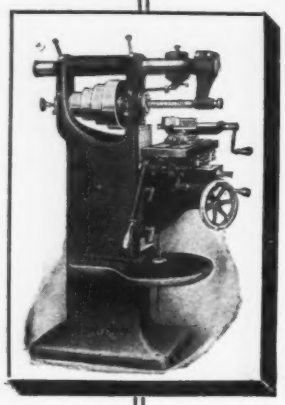
Uncle Sam is using a number of *Imperial Oxy-Acetylene Welding and Cutting Equipments* as FIRST AID to repair breakdowns of the big fleet of transportation trucks and other army equipment on the border.

The government, when seeking *quality of work* and *speed of accomplishment*, chose Imperial—it's a safe lead for you to follow.

Write today for big illustrated catalog showing work actually done, savings made, cost of operation, and other valuable data.

Imperial Brass Mfg. Co.

1224 W. Harrison St. CHICAGO

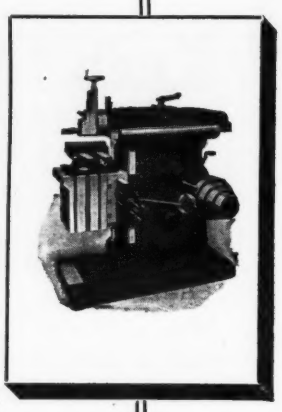


Cut Your Shop Costs

Nobody would think of putting 16-inch lathe work on a 30-inch lathe; then why leave small parts on a large Milling Machine? A Steptoe Hand Miller or small power feed can be handled quicker and will cut your production cost. You will have less money invested in your Milling Machines and have more machines to do the work.

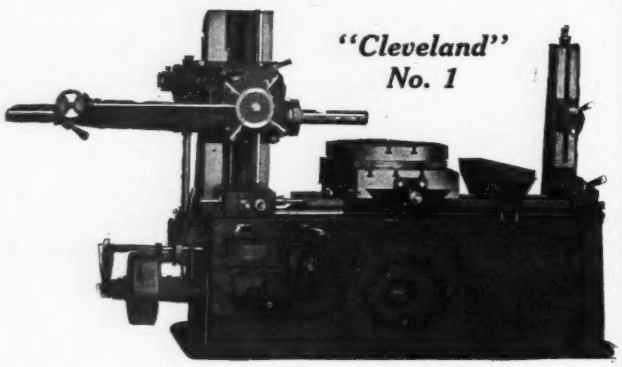
That same principle applied to your small planer work will cut the cost of planer work.

A Steptoe Shaper will do the work faster because it can be handled quicker.



THE JOHN STEPTOE COMPANY
BRIGHTON CINCINNATI, O.

The Cleveland Horizontal Boring, Drilling and Milling Machine



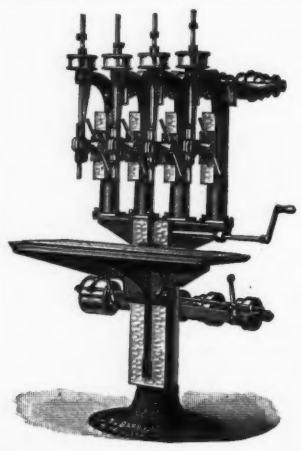
Unusual Range — Exceptional Speed

Bore, mill, drill, tap, etc., on the Cleveland "Horizontal." It's the machine to handle work at low cost. Strength and rigidity insure accurate output, and the system of centralized controls reduces the operating effort to the minimum.

In Cleveland Machines all gears are covered, all feed changes made by one handle, all changes of speed and feed made, without interference, while machine is running. Many other advantageous features. Write for complete description.

CLEVELAND MACHINE TOOL WORKS
Cleveland, Ohio, U. S. A.

Sloan & Chace Mfg. Co.
LIMITED
NEWARK NEW JERSEY
Manufacturers of
Precision Machinery and Makers of Dies, Tools, Fixtures
and
Special Machines
for Gun Makers.

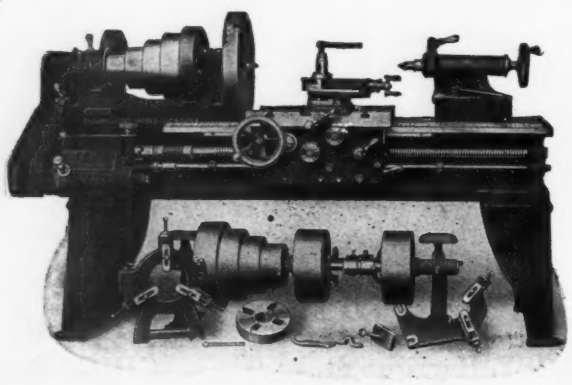


Barr Sensitive Drills

One to 6 Spindles

Lever or Power Feed

MADE BY
FRANCIS REED COMPANY
43 Hammond Street
WORCESTER, MASS., U.S.A.



CARE

In their alignment, in the selection of first-grade material, in machining to jigs, in the use of modern, practical equipment, and no special hurry to put through other than good work is the main reason why CHAMPION LATHES are a standard for accurate boring, turning, facing and screw-cutting lathe operations.

Designed with extra weight and every convenience makes them the ideal machine for Tool Room and Factory.

Four Sizes: 12-14-16- and 18-inch.

CHAMPION TOOL WORKS CO.
2422 Spring Grove Avenue CINCINNATI, OHIO, U. S. A.

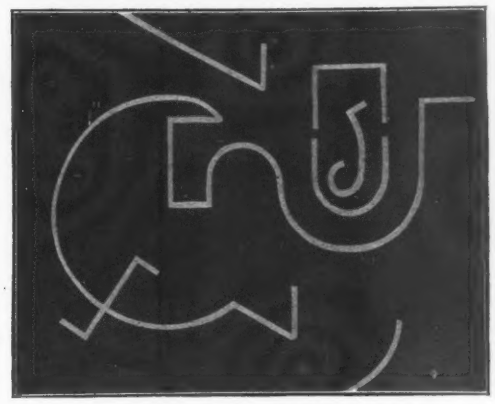
Gray's Sheet Metal Cutter No. 1

PATENTED

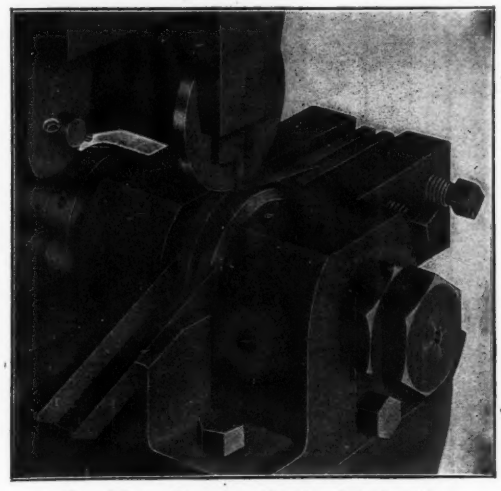
(Not a Rotary Shear)

For Cutting Out Gages, Templets, Jigs, Engine Liners, Gaskets, Gear Covers, Sheet Metal Guards and Kindred Articles.

Especially adapted for your experimental department and for special machinery building.



Steel Plate 10" x 18", 3-16" thick.



End View Showing Cutting Mechanism.

Makes handwork a quick mechanical proposition, and will save its cost in very short time. In use in leading shops of country.

Cuts any conceivable shape without changing true alignment of any portion of material, and at rate of 20 to 30 inches per minute. Maximum capacity 3-16" steel plate.

Write for complete details.

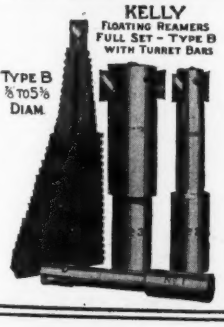
W. J. SAVAGE COMPANY, Inc.
KNOXVILLE, TENN., U. S. A.

The
HIGLEY
COLD METAL SAW

Catalog furnished by

Vandyck Churchill Co.
New York Philadelphia Pittsburgh New Haven

PRODUCTION TOOLS
The Kelly Adjustable Kind



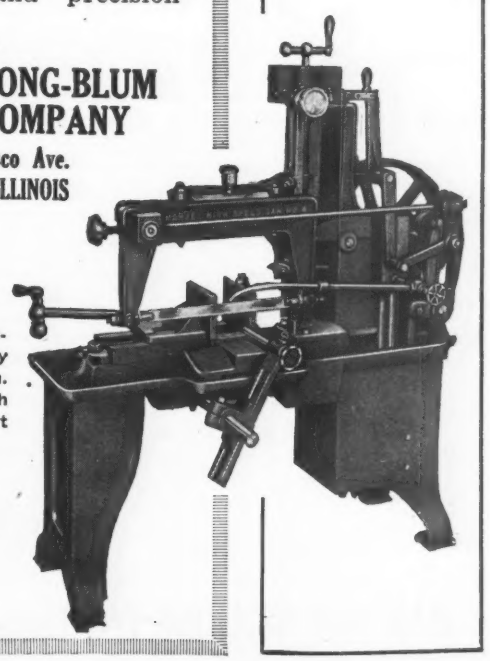
The Production Boss
"Don't Care a Cuss"

what **make** or **kind** of tool he uses—he wants **SERVICE**; he must have **continuous PRODUCTION.**

THE KELLY REAMER CO.
CLEVELAND, OHIO
C. W. Burton, Griffiths & Co., London, English Agents. Burton Fils, Paris. 40 Domestic Agencies.

This Marvel No. 4 High Speed Draw Cut Saw cuts 6-inch round cold rolled steel in 10 minutes, 5-inch steel in 8 minutes and smaller sizes in proportion. Its exceptional speed and accuracy, with the adjustable stroke, automatic stop, etc., make it a winner where speed and precision count.

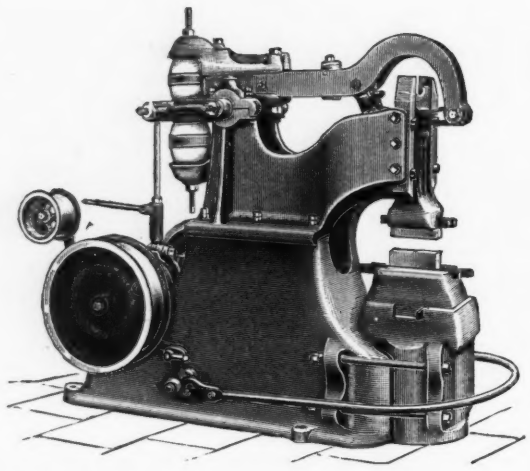
ARMSTRONG-BLUM MFG. COMPANY
343 N. Francisco Ave.
CHICAGO - ILLINOIS



Built for service. Capacity 6 in. by 6 in. Furnished with or without motor drive.

Catalog on request.

High Speed Accurate Cuts



Bradley Upright Hammers

Are made with heads weighing 15 to 500 pounds. Each contains one-third to one-half more material than those of any other make of the same rating.

Their anvil blocks weigh nearly or quite double those of other hammers.

Their output is guaranteed 25 per cent greater than is possible with other hammers of same rating, or no sale.

More Bradley Hammers are sold each year than all other power hammers combined.

WE MAKE

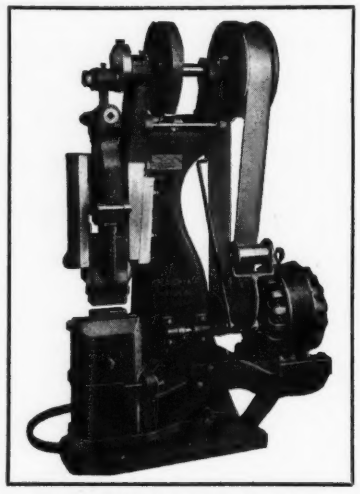
The Bradley Cushioned Helve Hammer **The Bradley Upright Helve Hammer**
The Bradley Upright Strap Hammer **The Bradley Compact Hammer**
Forges for Hard Coal or Coke

SEND FOR CIRCULARS

C. C. BRADLEY & SON, Syracuse, New York

FOREIGN AGENTS: Schuchardt & Schutte, Berlin, Vienna, Stockholm, Petrograd. Alfred H. Schutte, Cologne, Brussels, Liege, Paris, Milan, Bilbao. Buck & Hickman, Ltd., Whitechapel Road, London.

Beaudry Hammers
FOR GENERAL FORGING

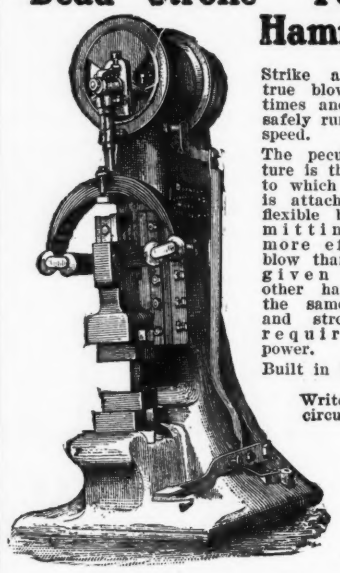


Save Fuel, Time and Labor.
Cut Forging Costs in Two.

Belt or Motor Driven

BEAUDRY & CO., Inc.
141 Milk Street BOSTON, MASS.

"Dead Stroke" Power Hammers



Strike a square, true blow at all times and can be safely run at high speed.

The peculiar feature is the spring, to which the ram is attached by a flexible belt, permitting a far more effective blow than can be given by any other hammer of the same weight and stroke, and requiring less power.

Built in 7 sizes.

Write for circulars.

MANUFACTURED BY

Dienelt & Eisenhardt, Inc.
1304 No. Howard Street
PHILADELPHIA, PA., U.S.A.

CHAMBERSBURG STEAM HAMMERS
"ALL SIZES FOR EVERY CLASS OF WORK"

Our hammers are double acting, have simple valve gear and give the operator perfect control. *Write us for details.*

CHAMBERSBURG ENGINEERING COMPANY, Chambersburg, Pa.
HYDRAULIC MACHINERY

NOT IN A TRUST

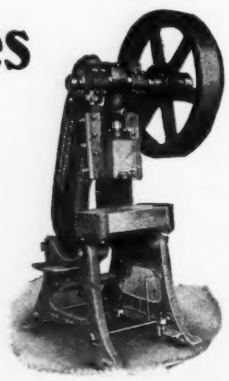
HAYES FILE COMPANY, Detroit, Michigan

USE OUR SPECIAL LATHE-CUT FILE FOR LATHE WORK
PRICES ON APPLICATION

Ams Presses

We spare no money nor pains to make our Presses the best that money can buy. Let us quote you on your next Press.

Address Dept. P 3



MAX AMS MACHINE CO., Bridgeport, Conn.

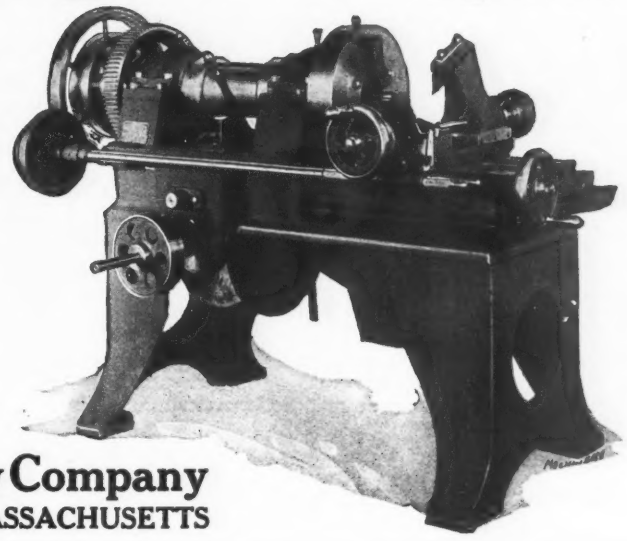
DROP PRESSES
for All Purposes Our Specialty

The Peck Drop Lifter can be readily applied to foot or hand drops.

MINER & PECK MFG. CO.
Proprietors of the PECK DROP PRESS WORKS
NEW HAVEN CONN., U.S.A.

The "Hurlbut, Rogers" for Speed

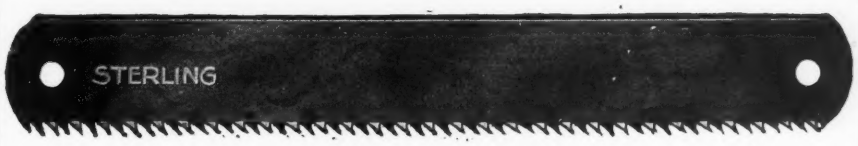
The Hurlbut, Rogers Cutting-off Machine cuts stock fast. It practically doubles the output of the ordinary machine and just about halves the cost. There are *two* cutters on the H-R; the ordinary cutting-off machine has but one. Besides speed, the Hurlbut, Rogers has strength, rigidity and power to handle the heaviest work with accuracy. It will cut your stock in record-making time at rock-bottom costs.



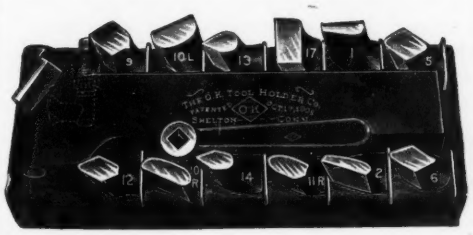
Ask us to show you. Capacity 2" to 10"

The Hurlbut, Rogers Machinery Company
SOUTH SUDBURY MASSACHUSETTS

"STERLING"
HACK SAWS

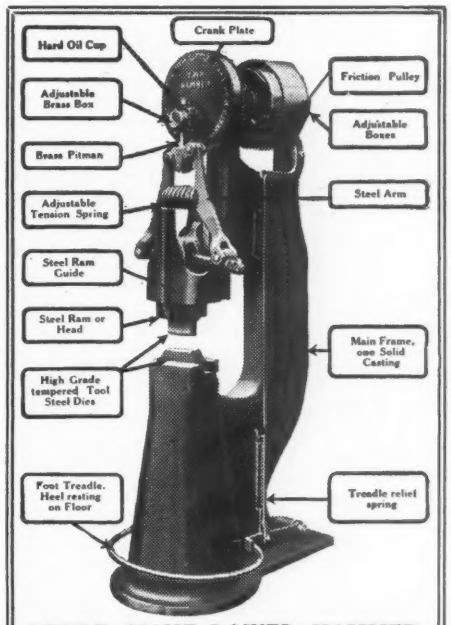


MANUFACTURED BY
Diamond Saw & Stamping Works
BUFFALO, N. Y., U. S. A.



Send for our new catalogue and learn how to save money on Turning Tools.

The O. K. Tool Holder Co.
SHELTON, CONN., U. S. A.



LITTLE GIANT POWER HAMMER
With or Without individual Motor Equipment — 400 R. P. M. — Machine Gun rapidity and Precision
Sold on 30 days' trial. Write your jobber or to us.
MAYER BROTHERS COMPANY
131 Rock St. MANKATO, MINN., U.S.A.

ORIGINAL
ROCKWELL FURNACES
For ANNEALING, TEMPERING, HARDENING, MELTING, Etc.
FUEL OIL APPLIANCES
Catalog 21 for the asking
W. S. ROCKWELL CO. 50 CHURCH ST., NEW YORK

Established 1902
MOBERG
DIE CASTINGS
We do not claim to be the only die casting concern in the country, but have customers who say we are.
C. J. MOBERG, Inc.
Beach Street, Mount Vernon, N. Y.

Genuine Armstrong Stocks and Dies

PIPE CUTTERS

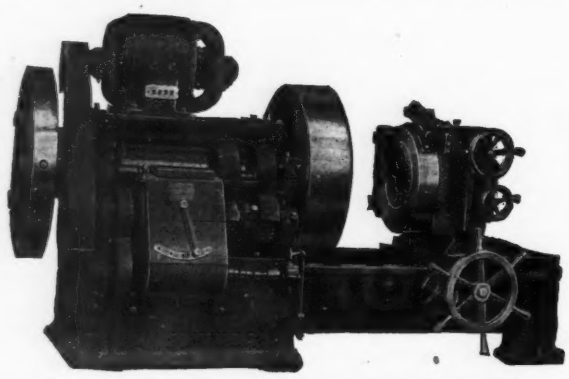
Malleable Iron Hinged Pipe Vises

PIPE MACHINES

MANUFACTURED BY

THE ARMSTRONG MFG. CO., 297 KNOWLTON STREET BRIDGEPORT, CONN.

The Method of Drive is an Important Thing in a Pipe Machine



Because a lot of time is wasted if the speed is not just right for every size and material of pipe.

The "Stoever" Pipe Machine

has a single-pulley drive with gear speed variation. This means that **the belt speed is constant,** not lowest when it should be highest. **The belt tension is always proportional to the power transmitted**—economy of power. **The belt contact is constant and always adequate.**

The "Stoever" has a friction countershaft which eliminates shifting belts and saves at least one-third in belting cost.

The gear speed variation affords a speed exactly right for every size of pipe, and for iron or steel. **This means maximum cutting and threading speed.**

Write for the "Economy" Booklets.

TREADWELL ENGINEERING CO.

Sales Office: 140 Cedar Street, New York

Works: Easton, Pa. TE 10

For Heavy Pipe Cutting and Threading

Catalog gives full description.

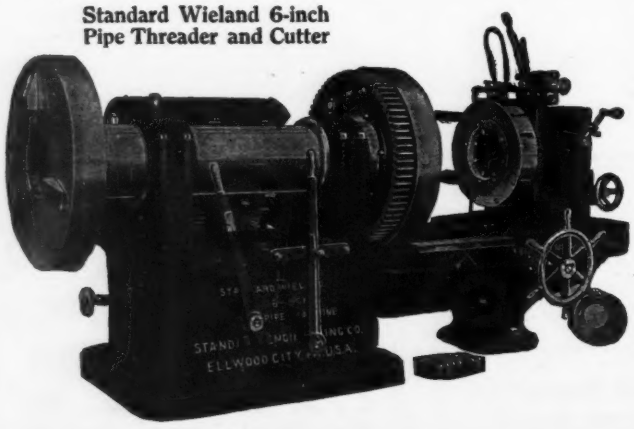
Curtis & Curtis Co.

8 Garden Street

BRIDGEPORT CONN., U.S.A.

THIS power-driven Forbes Pipe Cutting and Threading Machine is especially heavy in design, and built for hard service. It is equipped with four speed changes, oil pump and revolving dies, and is particularly compact—requiring five feet less floor space for working a length of pipe than any overhung spindle type machine. It is an economical, one-man machine for work up to 15" in diameter. Furnished for hand use if desired.

Standard Wieland 6-inch Pipe Threader and Cutter



Thread Pipe Do You? How?

The modern, efficient way is the Standard Wieland way, with a heavy, sturdy, durable machine, simple and positive in operation, fast and accurate in production. This machine costs more and is worth it; character and quantity of output prove it.

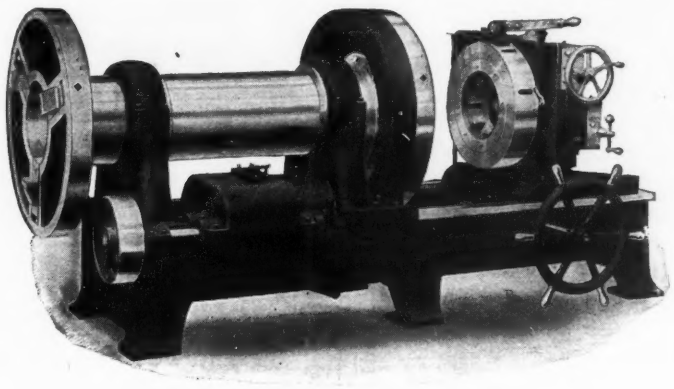
A few features: One-piece bed; single-speed pulleys; gear speed changes through semi-steel cut gears; deep chasers, cutting long taper threads in one cut perfectly, steel as well as iron pipe.

Send for the circular.

Standard Engineering Company

Ellwood City Pennsylvania

San Francisco Office: 1801 Claus Spreckels Bldg.



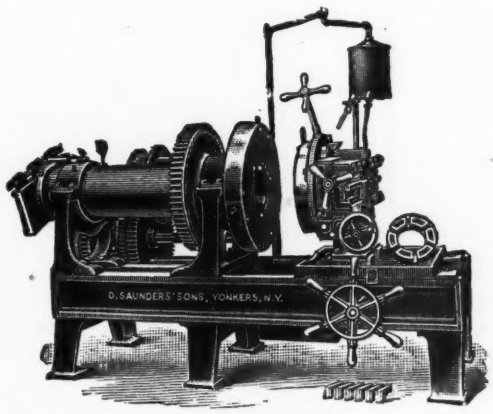
Cut Your Threads on a B&K and Remove the Frown

Frowns have no place around a Bignall & Keeler Pipe Machine. When a machine satisfies both the owner and the user, frowns are unknown. "Satisfies" is a big word when applied to pipe threading. There is the owner of the machine, the man who operates the machine, and the man who makes up the threaded joints. B. & K. Machines satisfy all along the line. *What size are you interested in?*

BIGNALL & KEELER MACHINE WORKS

EDWARDSVILLE, ILLINOIS, U. S. A.

SAUNDERS



Pipe Threading and Cutting Machine No. 6

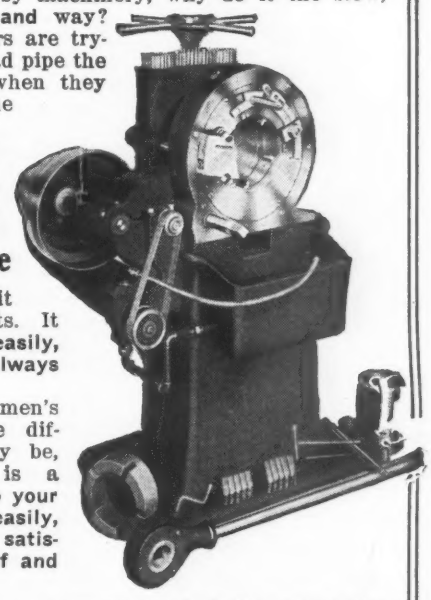
A strong, durable, rapid and easily operated machine which cuts and threads pipe from 2½" to 8" with absolute accuracy. No loose gears, large pulleys or tight belts. Uniform surface speeds on different diameters of work are provided by special gearing arrangement. Die head can be brought close to gripping chuck and short lengths threaded without a nipple chuck. No more efficient pipe cutter on the market than this Saunders No. 6.

Entire Saunders line described in Catalog P.

D. SAUNDERS' SONS, Yonkers, N. Y.

"In Days of Labor Difficulties Look to Your Machines"

If it can be done by machinery, why do it the slow, laborious, costly hand way? Many manufacturers are trying to cut and thread pipe the costly hand way when they ought to be using the



Merrell Power Operated Pipe Threading and Cutting Machine

A boy can operate it and get good results. It works quickly, easily, simply—and it always works.

Of course most men's pipe problems are different. Yours may be, too. But there is a Merrell made to do your work, and do it easily, economically and satisfactorily to yourself and your customers.

And, to prove what the Merrell will do before you agree to keep it, we will send you your Merrell on the condition that if it does not make good, we will.

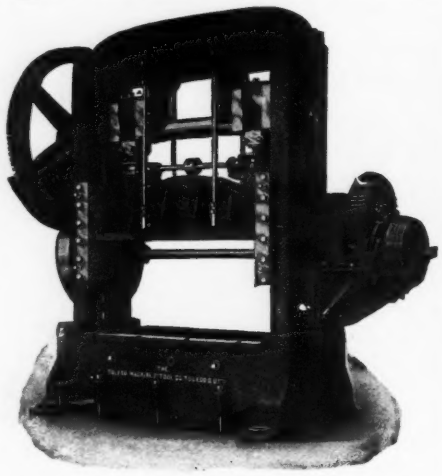
Get the Merrell catalogue A-16 to-day. That's the first step away from possible labor difficulties in one part of your business.

THE MERRELL MFG. COMPANY

15 Curtis Street **TOLEDO, OHIO**

"TOLEDO" Prestige Steadily Widens

among manufacturers who seek durable, efficient presses of consistent economy.



"TOLEDO"
Double Crank Presses

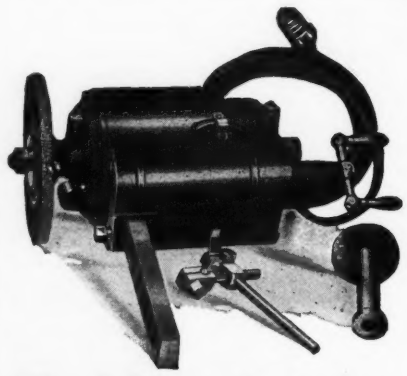
embody exclusive improvements and new features of the greatest advantage.

It is unnecessary to go into the details of the construction of these presses after half a century of tried and proven success.

They are furnished in over 150 sizes and adapted to every requirement of sheet-metal and drop-forging work.

Prompt Deliveries.

The Toledo Machine & Tool Company
TOLEDO, OHIO, U. S. A.



Tool Post Grinder
Hand Feed and Plain

For grinding Centers, Dies, Cutters, etc.

Does both Internal and Surface Grinding.

Supplied with 3/8 x 6" wheel internal grinding attachment.

Ten-foot flexible cord and plug to fit any standard lamp socket.

STOW MANUFACTURING CO.
BINGHAMTON, N. Y.
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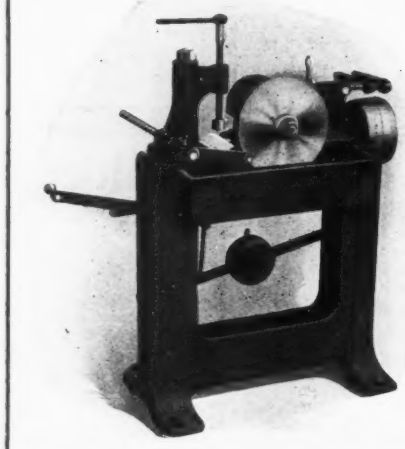

It's the Burr "No. 1"

A cold saw fitted with a 10-inch saw blade, 3/32 inch thick, of uniform hardness throughout—a machine that cuts any round stock up to 3½ inches diameter, accurately and fast.

Simple design and substantial construction are distinctive features. Drive is through a steel worm gear provided with ball thrust bearings and a steel pinion; automatic trip shifts belt to loose pulley at finish of cut.

Circular gives full description. Write us.

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Combination FILING Cabinets and Drawing Tables

Thoroughly well made and finished in Grand Rapids best style. Our Cabinets and Drawing Tables never fail to please the purchaser. Table and cabinet combination here shown is one of the most popular pieces.

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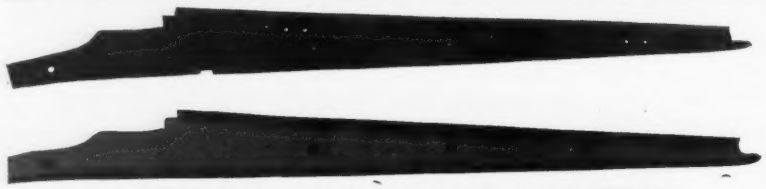

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It's taking a step in the right direction to replace castings with Acklin Metal Stampings. A trial will convince you that Acklin Stampings are cheaper, and more satisfactory in every respect. *Write for details.*

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PRESSES—Foot and power.
WIRE FORMING MACHINES—Standard or special.
TUMBLERS—All kinds.
BALL BURNISHING EQUIPMENT.
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and other articles for use in melting and refining metals
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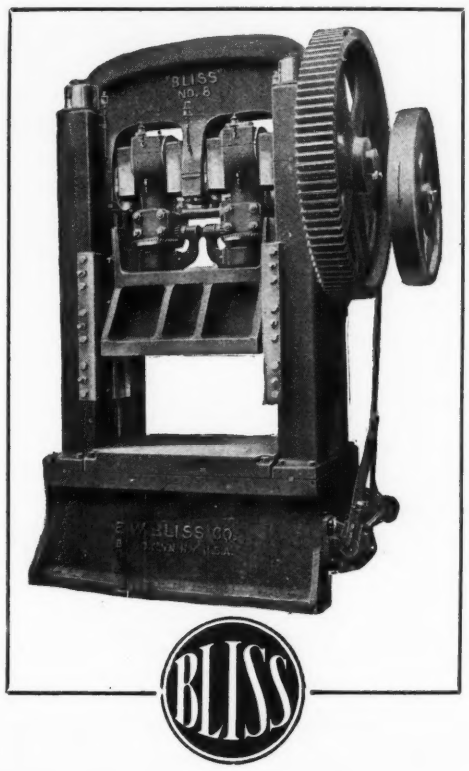

Presses with correct proportions for use in the manufacture of large sheet iron and steel goods. The large diameter shafts and well-gibbed sides allow quantity production that's profitable.

Bliss Double-Crank Presses

Adapted for the economical production of vapor stoves, wrought iron ranges, agricultural implements, automobile stampings, steel car parts, ceilings, sidings, metal doors, window frames and sashes, metal furniture and similar goods.

Built in over 150 sizes, there is one adapted to your special requirements. Write today for descriptive matter.

Talk to us about presses for any and every requirement.

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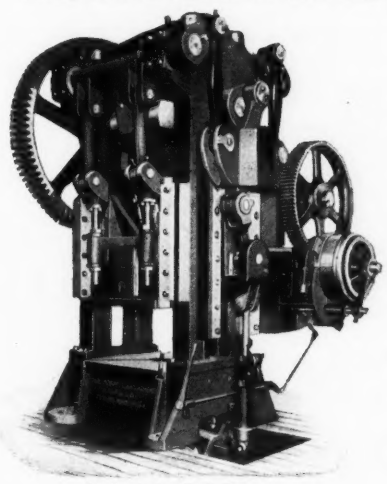
Perfect dwell and perfect timing—"Cleveland" Toggle Presses are unusually heavy in their proportions, and are built in all sizes—both single and double crank, for the production of all classes of drawn sheet metal parts. They are equipped with automatic or hand operated multiple disc friction clutches. Yokes, rock shafts, cranks and links are steel castings. All pin bearings are bronze bushed.



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SWAINE
No. 4 Double Seamer

A thoroughly dependable machine for accuracy in this line of work, and particularly adapted for high-speed production and quick adjustment. Vibration is reduced to a minimum by running the belt close to base of machine, and any lost motion that might occur can be readily taken up. This "SWAINE" has hardened tool-steel wearing parts, adjustable bed, two-speed arrangement, and is very strongly constructed.

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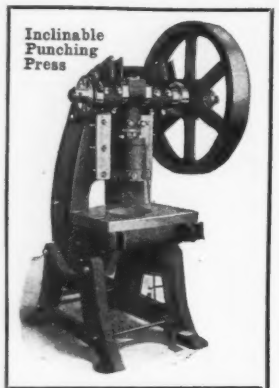
NIAGARA POWERP RESSES



Big Output
Long Service
Low Cost

The presses to install for hard service are "Niagaras." They have power and strength to stand continuous operation, means for quick and accurate adjustments, with reliable locking devices. Shafts are forged from high carbon steel and ground to size; bearings are extra large; surfaces are carefully scraped. No matter what your work is there's an economical "Niagara" to handle it.

Send for complete line.

NIAGARA MACHINE & TOOL WORKS
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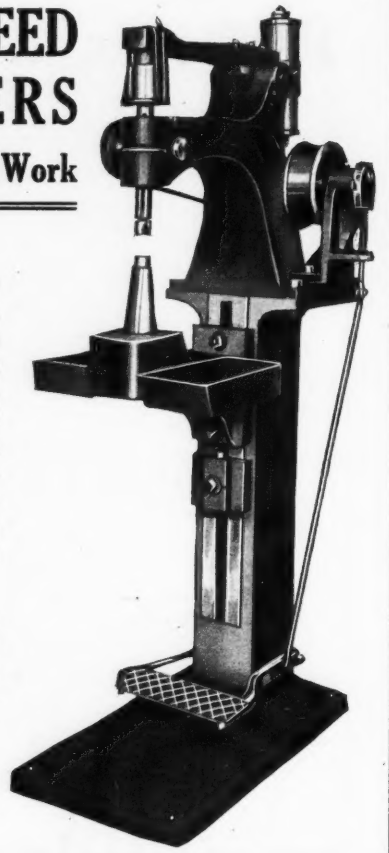
HIGH SPEED HAMMERS

For High Speed Work



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No riveting too intricate for us; no riveting which our machine cannot accomplish.

Send for our High Speed Hammer Book

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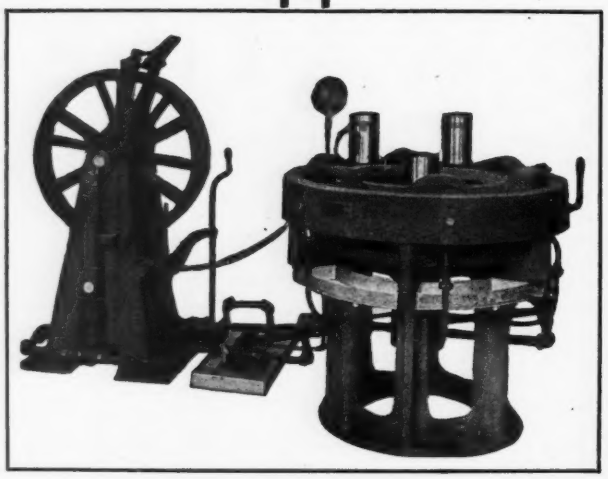

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An efficient, rapid-operating machine for compressing bands on shrapnel shells and for other work of a similar nature. Designed to handle work up to 15½" in diameter, and to follow specifications to the letter. A special feature of construction holds bands in position for entering groove without being set in by hammer.

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Copper Hammers

All Weights
From 4 oz. to 16 lbs.

Every shop should use them

Also

Soldering Coppers
Eureka Style
Best in the World

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North East, Pa.

A High Class "Radial" at Low Cost

Production is often limited because of the absence of a radial drill, high investment cost preventing its installation. The No. 51 Canedy-Otto Self-Feed, Wall Type Radial Drilling Machine relieves the pressure. Reasonably priced—within the reach of any manufacturer—and handles a wide range of work just as satisfactorily as higher priced drills.

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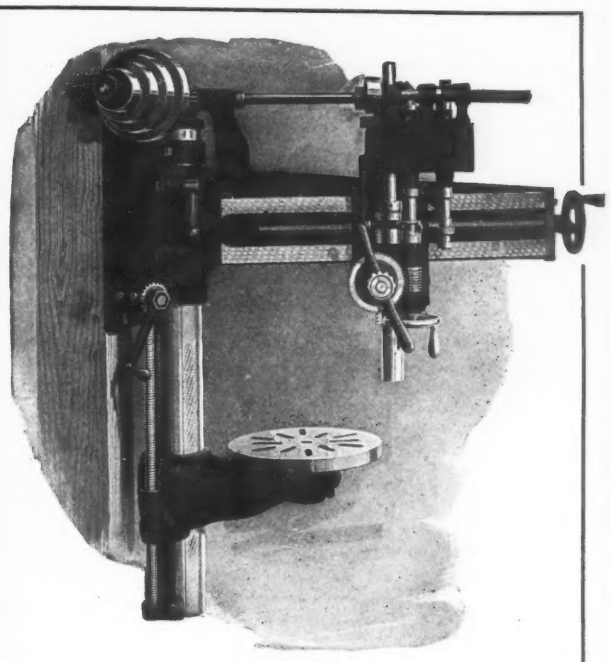

PRICES

No. 51—2½ ft. Arm - - - - - $175.00
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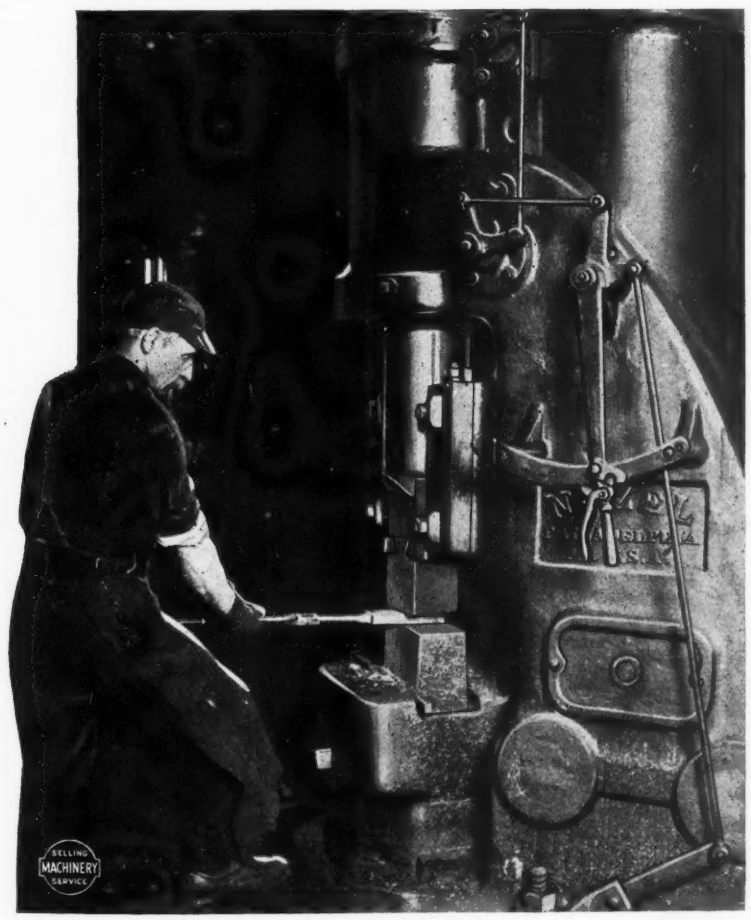
Carried in stock by leading jobbers and machinery dealers everywhere. Send us your name and we will give you the name of our dealer in your locality.



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The "Nazel" is a one-man hammer. In most cases a second operator wouldn't increase the amount of work nor the accuracy with which it is handled. The foot control is perfect and adequate for all except work too heavy for one man to handle and run the hammer at the same time.

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50-ton Hydraulic Press for Briquetting Granular Materials

Hydraulic Briquetting Presses

We Build Briquetting Presses For a Great Variety of Purposes From Briquetting Coal Dust, Sugar, Salt, etc., to Making Concrete Building Blocks.

We show here a small press for experimental purposes, to determine the pressures, volumes, etc., required for briquetting granular materials.

It is equipped with hand pump and gauge so that the pressure applied can be accurately controlled and indicated.

The briquetting mould can be made in various shapes and sizes.

If you need presses for any purpose, write to us. Our line of over 4000 complete machines probably offers a press to meet your needs. If not, our 60 years' experience is at your disposal.

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295

Thread Millers

Do You Need Them?

We are filling rush orders for Smalley-General Thread Milling Machines fitted for eight, nine and two-tenths and twelve inch shells, and making good delivery on all sizes. The Smalley-General line includes Thread Millers in sizes to handle shells up to 16 inches. Belt or motor drive.

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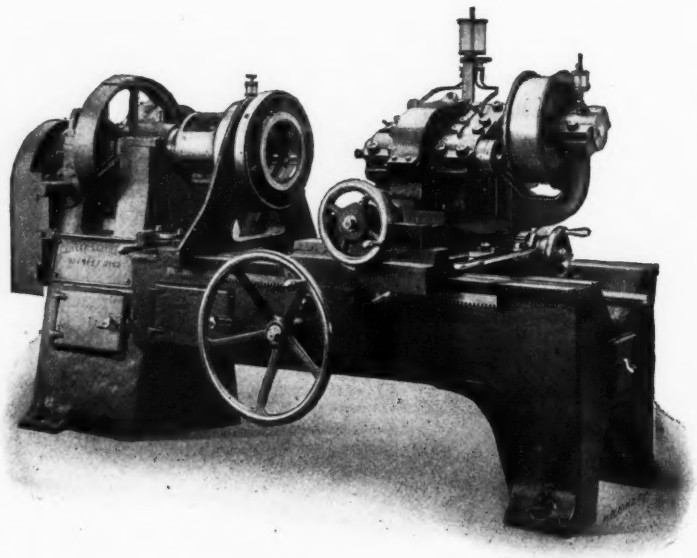

Smalley-General Co.

BAY CITY, MICH., U.S.A.

FERRACUTE PRESSES

FOR CUTTING, FORMING AND DRAWING METAL

PRESS S-D 705

Double-action Toggle Drawing Presses, all widths, giving pressures of 100, 150, 200, 300, 400, 500, 700, 1000, 1500 and 2000 tons.

The press shown exerts 700 tons pressure. Ram stroke up to 18 inches and plunger stroke up to 36 inches. Distance between columns, 124 inches. Friction clutch.

Photographs and full information for the asking.

FERRACUTE MACHINE CO.
BRIDGETON NEW JERSEY

The Etna Cutting-Off Machine

Equipped with features heretofore found only in high priced machines, and possesses all their advantages with lower investment and operating costs. The double cut-off insures a square, true cut, while the centering attachment, correct to within .005″ is available, if desired. Etna construction is strong and rigid; these machines are built to withstand heavy cuts and hard service. Made in 2″, 3″, 4″ and 6″ sizes.

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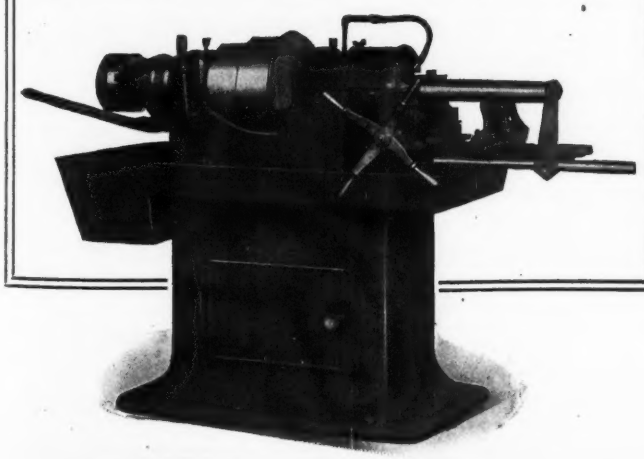

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Every Shop Has Use for This Hydraulic Straightening Press

EVERY medium or large machine, automobile, repair or railroad shop has use for this 250-ton Inverted Hydraulic Forcing Press for Bending, Straightening, Broaching and Miscellaneous Forcing work which is sure to come up daily. Its adaptability to a wide range of such work is unsurpassed, two of its features being a large pressing bed and an adjustable daylight space.

For small shops and smaller work we have hydraulic presses of the same type in smaller designs and lighter pressure capacities.

Just ask us about any type of hydraulic bending or straightening press—we have it. Shall we send you catalogs and bulletins?

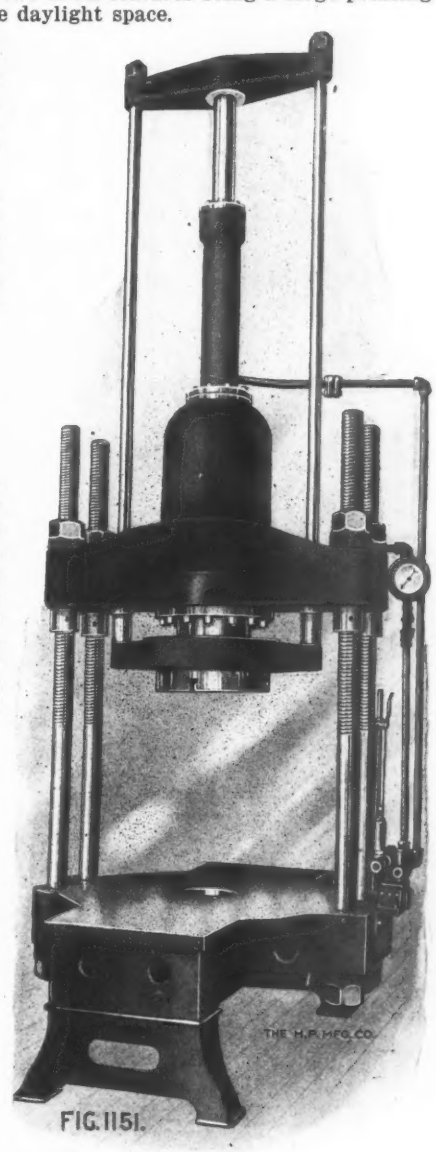

FIG. 1151.

Whatever Your Pressing Problems May Be—We Have the Press

No matter what or how intricate your pressing problems may be, we have a design to exactly fit your requirements. We have been building hydraulic equipment exclusively for 40 years. Here is only a partial list of our products:

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Shell Banding Presses
Shell Drawing Presses
Shell Forging Presses
Shell Nosing Presses
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Hydraulic Valves

Shall we send you bulletins on any of this equipment?

The Hydraulic Press Mfg. Co.

84 Lincoln Avenue MOUNT GILEAD, OHIO

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"FOR YOUR MG PRESSING NEEDS"

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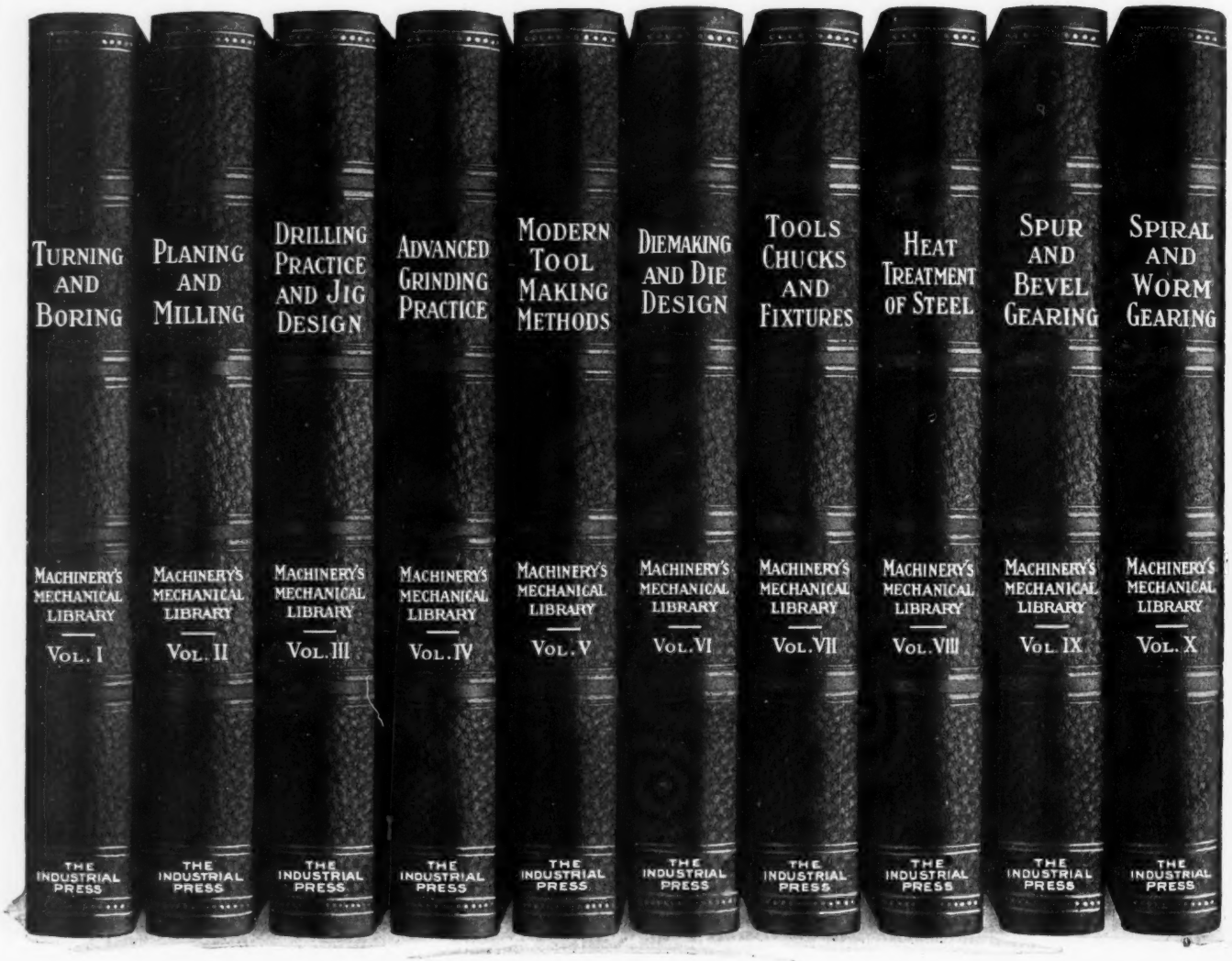

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is an investment which will return you many hundred per cent.

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It is perfectly safe to say that no mechanic can hope to achieve any special degree of success in his work unless he mixes brains with it. All good mechanics are thinkers, as the complete machine or tool is itself the realization of thought. The great thinkers are all great readers, which follows logically, for reading gives knowledge, without which, thinking, and especially thinking along mechanical lines, can't go far. These books cover the fundamentals, and with authority. They explain the engineering principles, describe the mechanical details and show all the significant shop operations. They present in simple and concise style the whole of modern machine shop practice. A great many books are written by men whose only sources of information are other men's books. MACHINERY'S books come straight from the shops—from the men who are engaged in shop practice. They are edited by MACHINERY'S staff, who are constantly roving through the most advanced shops everywhere, studying the latest methods, photographing the most interesting and efficient shop operations, gathering right at the sources, the actual figures of production. This is the kind of information you want. No matter what books you own, they are not quite like MACHINERY'S. You may have full 10 days to look them over before you decide to purchase. We take all the risk and expense.

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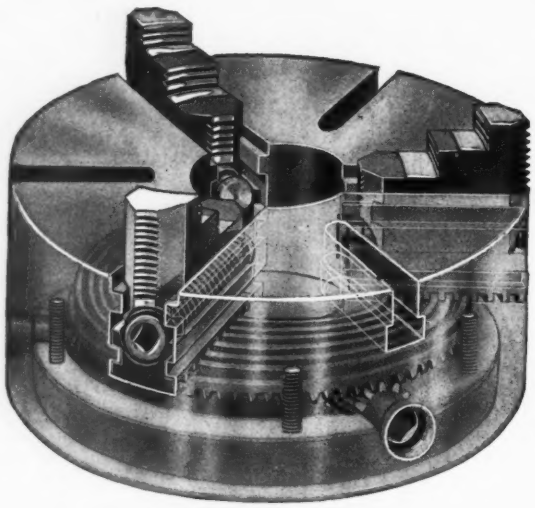

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Geared Scroll Combination Chuck

Operating Universally the jaws give that united strength that is found only in well-made scroll chucks.

Operating Independently the jaws in this chuck will hold just as rigid as those of any Iron Independent Chuck.

This Chuck is Substantially and Carefully constructed with the expertness that characterizes the **Union Standard.**

Profit by Our Experience.

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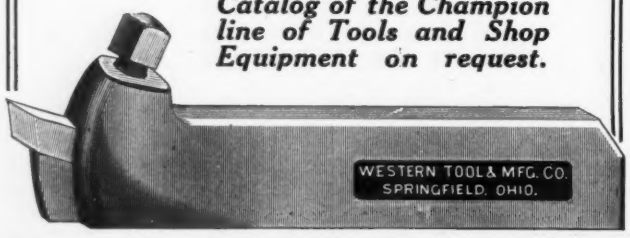
Makers of a Complete Line of Chucks

Catalog of the Champion line of Tools and Shop Equipment on request.



"Champions" That Deserve the Title

Champion products did not win their reputation without competition; it took a stiff fight to show they would produce better results than the other fellow's—and win the decision.

Champion Tool Holders

Are good examples of the Champion line. A big advantage is the heavy support under the cutting edge which prevents mashing down under continued strains. These holders use cutters close up, are strong, durable and make heavy cuts possible with rapid operation.

Champion Tool Stands

A typical piece of Champion Shop Furniture. Made of cast iron or sheet metal, with or without drawer. Strongly built and easily moved. A real economy in any shop.

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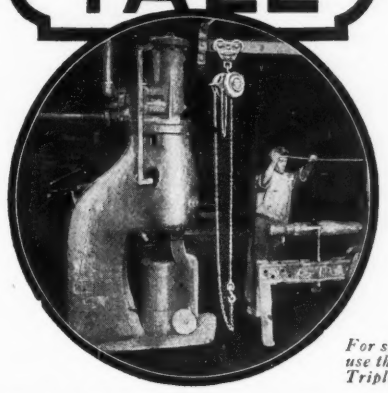
YALE



For shock loads use the Yale Triplex Block

The Steel Vitals of the Yale Triplex Block

From Yale's early recognition of the danger of suspended loads came Yale Safety Hooks. A visible warning of over-strain which the operator must *handle* before the load can be lifted.

Yale Steel Suspension Plates connect the upper hook and the load sheave, supporting the load. With this construction wrought steel, not castings, resists shock or overload.

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All that You Need for Economical Threading

is found in the "Ideal" Self-opening Die. You can cut clean, straight, accurate threads regardless of pitch or size. In the "Ideal" the head revolves around a stationary cam, thus utilizing the belt power or cutting strain as the opening power. Chasers supported directly back of cutting strain—no tendency to bell out and cause taper threads. With this tool you can cut threads as cheaply and efficiently as with any die on the market. We can prove it, too. Ask us how.

IDEAL TOOL & MFG. COMPANY

BEAVER FALLS PA., U. S. A.

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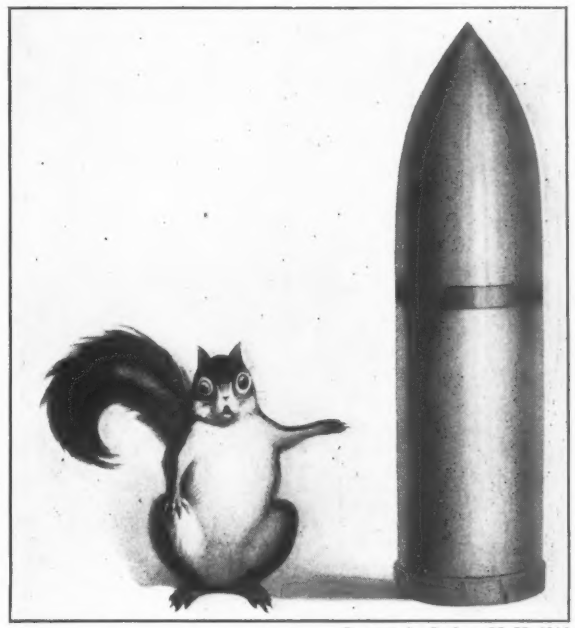

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"IF THAT'S A SHELL, I'M A NUT"

Write for a copy of this mid-year

Aqualene

[Trade Mark Registered]

CALENDAR

with the above attractive four color illustration from *Judge*.

We will also send our booklet telling of the splendid results many shell makers and other machine tool users are getting from Aqualene — the Scientific Cutting Lubricant.

Crescent Oil Company

54 Church Street, New York

Factory and Laboratory
Indianapolis, Indiana

NEIDOW & PAYSON CO.
9 South Clinton Street
Chicago, Ill.

British Agents
Nat'l. Engineers Supply Co.
Liverpool

CRESCENT OIL COMPANY, 54 Church St., New York
Please send me a copy of your "Aqualene" Calendar.
Name.....
Address.....
City.....

"DOEHLER" Die-Cast Speedometer Case

DOEHLER DIE-CASTINGS

are the *standard* by which *all* die-castings are compared. **"DOEHLER"** quality and **"DOEHLER"** service have attained for them this enviable position.

"DOEHLER" QUALITY is more than a mere phrase—it is an achievement attained by rigid adherence to the use of virgin metals of the highest grade obtainable—by scientific alloying—and by skillful casting.

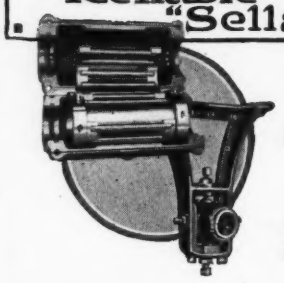
"DOEHLER" SERVICE is *all* that the word implies.

The fact that **"DOEHLER"** die-castings are extensively used by the largest and most conservative manufacturers of automobiles and automobile accessories, is ample proof of their merit.

DOEHLER DIE-CASTING CO.
BROOKLYN. N.Y.
NEWARK. N.J. TOLEDO. OHIO.

Producers of Die-Castings in Aluminum, Tin, Zinc, and Lead Alloys — Manufacturers of Babbitt-lined Bronze Bearings

"Old Reliable" "Sells"



Who buys "SELLS" Bearings—and then buys them again?

The makers of Gillette Safety Razors

During the last few years Gillette Safety Razor Co. have installed a large number of "Sells" Roller Bearings in their enormous Boston plant, and write, "We are obtaining satisfactory results."

The makers of Goodrich Tires

The B. F. Goodrich Company has one of the largest plants in the world at Akron, Ohio, devoted to the manufacture of tires. During the last year their orders have totaled about 1000 "Sells" Bearings.

The makers of 65% of all railroad cars

The American Car & Foundry Co. operate great plants in various parts of the country, in the last three or four years building large new plants in Chicago, Berwick and Detroit, equipping completely with "Sells." At the Detroit plant alone between 400 and 500 "Sells" Bearings have been ordered during the year.

Other enormous concerns "come back" just like these big ones—Baldwin Locomotive Works, Standard Oil, Bethlehem Steel, and many others besides.

And aside from their other excellent qualities, one of the chief reasons for these continued purchases is that **they fit practically all standard hangers**, and can be installed over night.

John D. Sells
Manager.

Royersford Foundry & Machine Company
54 North 5th Street Philadelphia

Babbitted Ring Oil Bearings—Shaft Hangers, Collars and Couplings—Punches and Dies—Punching and Shearing Machines—Sensitive Drill Presses—Drill Presses—Foot Presses—Grinding and Polishing Machines—Tumbling Barrels—"Rollerine," the ball and roller bearing lubricant.

For Cyanide Hardening, Use

FERRO CASE

The efficient case-hardening chemical

Better than cyanide or any compound, and cheaper. Approved by the largest consumer in the country. A trial will convince you.

Write for fuller details and prices

C. G. BUCHANAN CHEMICAL CO., Cincinnati, Ohio

Two Salient Features of Conway Patent Friction Clutches

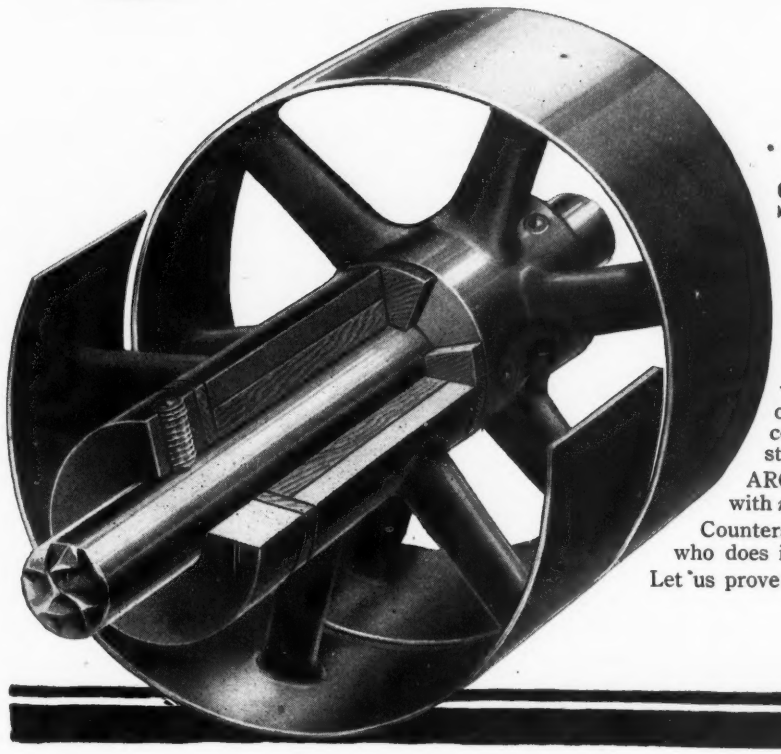
(a) The Leverage is compounded
(b) The Fulcrum Floats

Therefore (a) Power and (b) Complete and Perfect Contact are assured.

Conway & Company, Cincinnati, O.

Manufacturers of Friction Clutches since 1895
Publishers of CATALOG 12 B.

Arguto Oilless Bearings



SAFETY demands *self-contained* countershaft bearing—and it demands one that wears for years without attention—one that is self-contained because it *itself* takes care of its lubrication.

Forgetting Arguto Oilless Bearings for the moment—haven't the drastic, expensive (but undoubtedly beneficial) compensation laws been caused by *preventable* accidents?

—like the case of a man oiling a countershaft bearing, whose clothing happened to be caught by a moving belt, or whose ladder may have been pushed—*accidentally,* of course—but pushed enough to break his neck when he struck the floor.

ARGUTO has a record of over *fifteen* years' daily running with *no* lubrication and *no* attention, and with *hardly any* wear.

Countershaft bearing lubrication—and the risk to the human who does it—is eliminated by ARGUTO.

Let us prove this to you in your own shop now.

Arguto Oilless Bearing Company
145 Berkley Street, Wayne Junction, Philadelphia

Call In the Doctor For Those Worn Cutters

We're specialists in recutting old cutters and would like to prescribe for that scrap-pile of yours. In nine cases out of ten they can be recut to give the same service as new cutters and at one-third the cost.

Our service renews the cutter, preserves the original temper and will reduce your cutter expenses 50 per cent at least.

We'll recut one of your old cutters and return it prepaid; no charge unless absolutely satisfactory.

SUTHERLAND TOOL CO.
Formerly Flint Tool Salvage & Machine Co.
FLINT, MICHIGAN, U.S.A.

Perfect Balls of Steel

MANUFACTURERS realize the big importance of perfect sphericity in ball bearings. These bits of steel are responsible for the easy-running qualities of any machine. One imperfect bearing will cause unending difficulties.

Hoover Steel Balls are recognized and acknowledged to be *"perfect"* wherever steel balls are known.

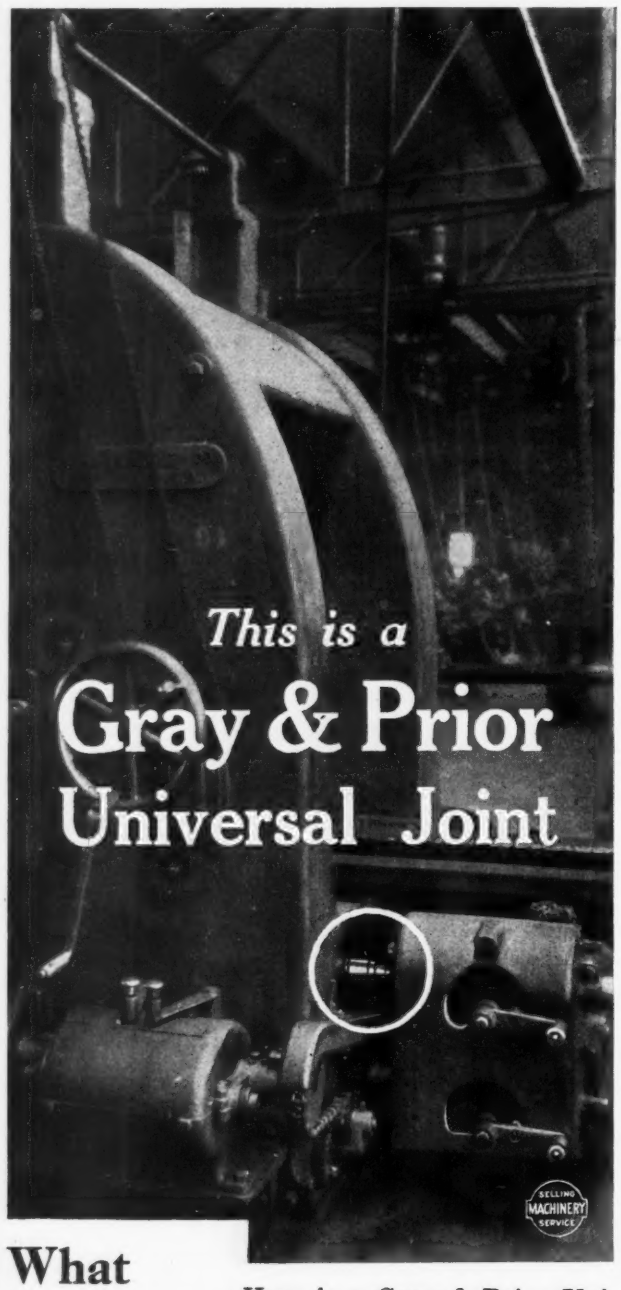
HOOVER
"Micro-Chrome"
STEEL BALLS

are manufactured from finest grade materials. Every ball is carefully tested and must be equal to the task of bearing the tremendous crushing strength of over 100,000 pounds. Hoover Steel Balls are accurate to 1/20,000 inch.

Over 12,000,000 Steel Balls Every Day

This enormous daily output enables us to give prompt attention to all orders. Write for Catalog No. 1.

HOOVER STEEL BALL COMPANY
ANN ARBOR MICHIGAN, U.S.A.

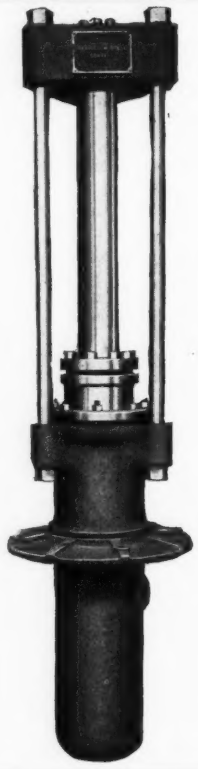


What Do You Suppose the Foreman Said?

Here is a Gray & Prior Universal Joint on a four-head milling machine made by the Beaman & Smith Company, which has been in use for five years in the factory of the Mianus Motor Works, Stamford, Conn. Has it given satisfaction? This question had never occurred to the foreman at the Mianus Works until recently, when he was asked about it, and it then suddenly dawned upon him that the joint had been running for five years and he had never given it a thought. Upon close inspection it was found that the joint was in every way as good as the day it was installed—a little more limber if anything. Therefore, a little improved.

For machine tool purposes Style "A" Gray & Prior Universal Joints fill all needs. They are compact, inconspicuous, hardened all over and give general satisfaction. A universal joint is a small thing; but you know the saying about a chain and its weakest link. Investigate Gray & Prior Joints—now.

The Gray & Prior Machine Co.
38 Suffield Street HARTFORD, CONN.



Hydraulic Intensifier

BETHLEHEM STEEL COMPANY
MACHINERY DEPARTMENT
ENGINEERS AND MACHINERY BUILDERS
SOUTH BETHLEHEM PENNA.

Save Money

Have Them Stamped

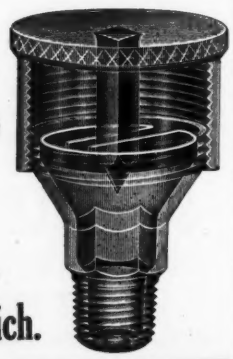
PERHAPS a lot of the small parts you are using are costing you more than they should. Have them stamped! Cheaper, also stronger and better looking than castings. Put the job up to us.

We are stamping specialists, with unsurpassed facilities for quick delivery. Let us figure a job for you.

Erie Stamping & Mfg. Co.
ERIE, PA., U. S. A.
Murcott-Duden Co., New York Representatives, 253 Broadway

GREASE CUPS
Pressed Steel and Brass

Oilers
Oil Cups
Spring Shackle Bolts
Dowel Pins



Write today for Catalogues and Prices

The Winkley Co., Detroit, Mich.

Would You Save $300.00 a Month

—or even a part of it?

Think of the number of tools which were hardened by fuel-burning furnaces, that are continually breaking in your plant—the necessary delay in replacing these tools and the machines that are idle while these tools are being replaced. Think of the money that is wasted in the breakage of these tools and the loss in dollars and cents it means to you during just one month.

HOSKINS
TRADE MARK REGISTERED

Electric Furnaces

Consider now the tools that are hardened in a Hoskins Electric Furnace where the temperature is accurately controlled and where every part of the tool-body, edges, and thin parts are heated alike, eliminating all internal strain and preventing the liability of sudden breakage in the tool.

In a plant where tools were heated in fuel-burning furnaces and the tool cost was $1000.00 a month, a saving of $300.00 a month was made when a Hoskins Electric Furnace was installed.

Hoskins Electric Furnaces have cut many tool bills in half—and in many instances the saving has been from 50 to several hundred per cent.

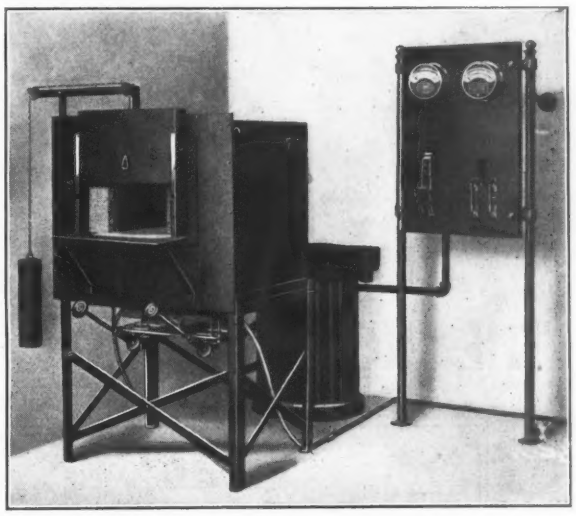
Write for bulletin describing Hoskins furnaces, giving us some information regarding your tool specifications, and let us show you how to reduce your tool cost, and recommend a Hoskins furnace for your own particular needs.

HOSKINS MANUFACTURING CO.

459 Lawton Avenue Detroit, Michigan

Otis Bldg. CHICAGO — Oliver Bldg. PITTSBURGH — Grand Central Terminal NEW YORK — 185 Devonshire St. BOSTON

Canadian Hoskins, Ltd., Walkerville, Ont.



Hoskins Type FC Muffle Furnace. Produces temperatures up to 2500° F.

LEIMAN BROS.

Used for creating high heat with gas and oil burning appliances, furnaces and blowpipes; for agitating liquids; for sand blasting; for vacuum cleaning and cleaning with air jet, also extensively used with

Automatic Machinery and Other Devices

Positive Powerful

The wings and cylinder wear in perfect conformity—the surfaces become glassy-like in their smoothness—this means easy operation and little power required.

High Pressure
BLOWERS and VACUUM PUMPS

"Take up their own wear"

NINE SIZES 4 to 338 cubic feet per minute. 1 ounce to 10 lbs. pressure. 1 to 20 inch vacuum.

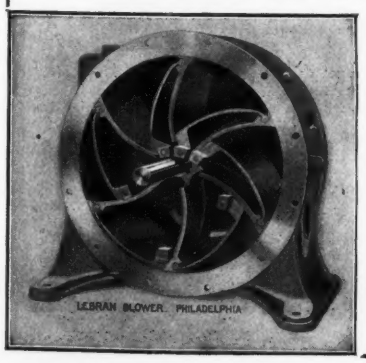
Specially fitted machines for higher degrees of vacuum.

A blower or vacuum pump that is durable—that can't get out of order—it's too simply constructed for that—utilizing the natural principle of centrifugal force—this force is always present when the machine is in motion—never wears out.
If we say our machine will do your work—if we say it will do it well then it will more than do it—don't overlook that—we don't overrate them—most every buyer tells us the same thing—but in not claiming too much we assure satisfaction.

LEIMAN BROS., NEWARK, N.J.
New York Office, 62 John Street

Positive Pressure Blowers and Vacuum Pumps Patented

In all sizes and for all services.



"Built Like A Machine Tool"

Quiet — Durable — Efficient

Will positively deliver their full rated capacity. Liberally designed.

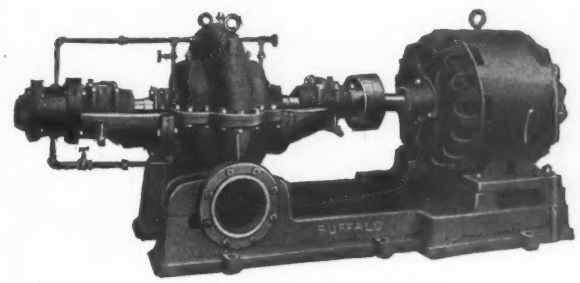
Write for data.

QUICK DELIVERY

THE LEBRAN CO.
940 N. 9th St., Philadelphia, Pa.

Steel Works Pumps

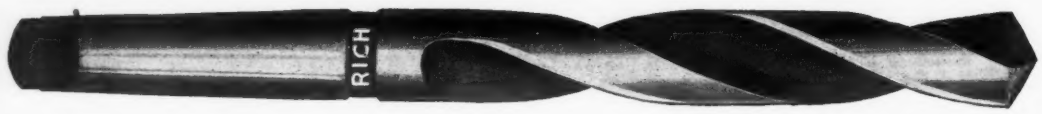
Main Line or Auxiliary Service



"Buffalo Pumps" are built for capacities up to 50,000 G. P. M. and heads as high as 1000 feet. Both single and multi-stage pumps have horizontally divided shells and double suction runners.

Buffalo Steam Pump Company
Buffalo, N. Y.

Branches in all Principal Cities



REAL DRILLING STAMINA

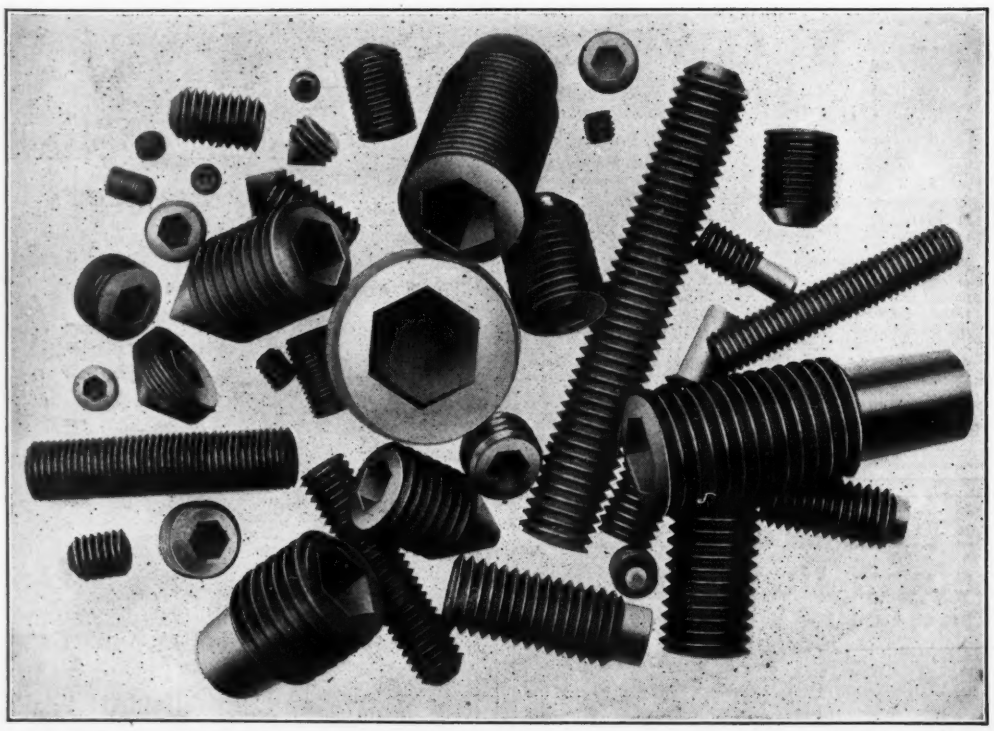
There's a quality in Rich Drills that enables them to stand a hard production pace in a manner truly surprising. Don't take our word for it, just watch one of them at work. No burning or binding. A clean cut right through. No frequent trip to the grinder, either—Rich Drills stay on the job. The kind of drill service you want is in Rich Drills. Look for that name on the shank—it means profitable results.

Send for Catalog describing the full line of

RICH TOOLS

THE RICH TOOL CO., 410-A Railway Exchange, Chicago, Ill.

ALLEN
Socket Cap
Screw



ALLEN
Socket Cap
Screw

Allen Safety Set Screws—Every Diameter, All Lengths

Allen Safety Set Screws are made in every diameter, every length and every shaped point for any purpose to which a safety set screw can be put. The diameters range from ¼ inch up to 1½ inches.

All "Allen" Screws are made by a Patent process which produces a clean socket and adds 30% more strength to the screw.

Write for Catalog No. 12 and free sample screws.

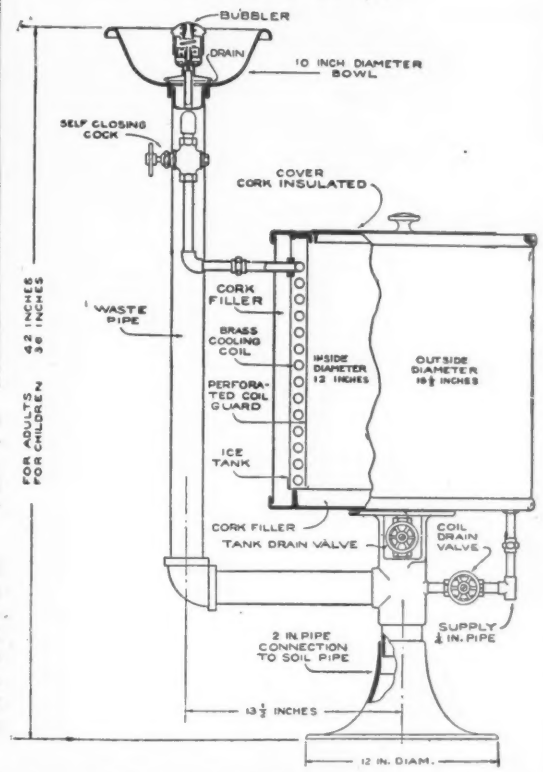
The Allen Manufacturing Company, 135 Sheldon St., Hartford, Conn., U.S.A.

Peoples Life Iusurance Bldg., Chicago, Ill. 173 Princess Street, Manchester, Eng.

What It Does

M. E. & E. Ice-Cooled Bubbling Drinking Fountain

What It Is



Holds 75 pounds ice; 15½ coils brass pipe; supplies 150 persons; **to be attached to municipal water supply;** sanitary throughout, and economical of both ice and water. Write us your requirements.

Our line includes Wash Bowls, Metal Lockers, All Steel Stools and Chairs with Inset Wood Seats, Stock and Storage Racks, Metal Shelving, Metal Vault Fixtures, Improved Soda Kettles, 40 and 60 gallons, Water Heaters and Instantaneous Mixers, Bubbling Drinking Fountains, Work Benches and Bench Legs, Drawing Stands, etc.

MANUFACTURING EQUIPMENT AND ENGINEERING COMPANY

136 Federal Street **BOSTON, MASS.**

IT NEVER MOVED

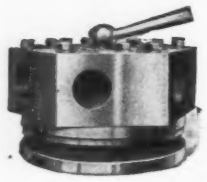
The Swivel Base of the Athol Vise Can't be Started this Way

You have used the old types of Swivel Base Vises—one with the pin that drops in a hole, or the one that clamps on a bench with the lever underneath. The one with the pin either becomes loose from wear or sticks tight when you wish to move it—the ones which depend upon friction alone slip when you need them most. It is different with the "Athol." You turn the lever and loosen a taper block having corrugated sides that mesh in the corrugated slot just as the phantom view shows. We're proud of this construction. It doesn't wear loose—it won't stick nor can it be "started" by any strain, no matter how severe.

The "Athol" line comprises vises from the simplest to the new Starrett improved vise shown above—vises for every purpose—and *all* good. We want to acquaint you with the line and send a catalogue for your files. Ask for it.

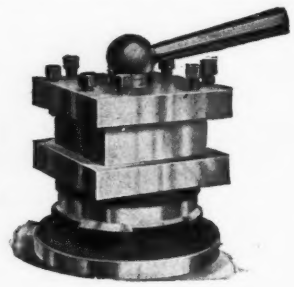
ATHOL MACHINE COMPANY

ATHOL, MASSACHUSETTS, U. S. A.



Phoenix Turret Attachments

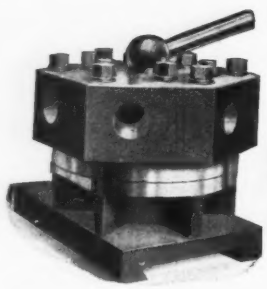
Give an Engine Lathe the Capacity for Handling Turret Lathe Work—Ideal for Short Runs



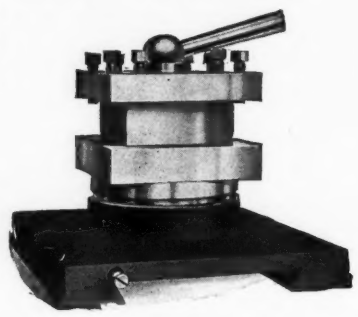
Every shop is confronted, more or less frequently, with the perplexing problem of doing difficult work in small quantities. It seems unprofitable whichever way it is handled. On the turret lathe—not enough pieces to make up for time lost in setting up. On the engine lathe—too many tool changes to make it pay. What's to be done? Use a

Phoenix Turret Toolpost or a Phoenix Carriage Turret

These attachments fit any engine lathe, are quickly adjusted, and provide a profitable means of doing such odd jobs. A three-quarter turn of the handle releases the rigid locking device and brings the next tool into play without re-adjustment. Convenient—adaptable.



Circulars and prices on request.



Phoenix Mfg. Co.

EAU CLAIRE WISCONSIN

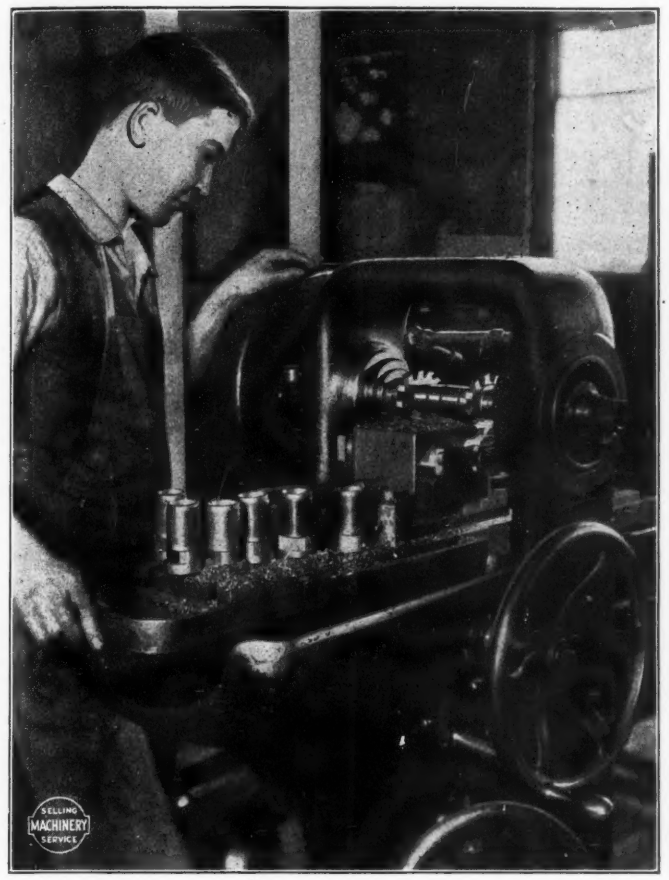
Cleveland Office: 1430 West 6th St.

The Superior 18-inch Engine Lathe

belongs in the first rank of modern high-grade manufacturing machines. Designed for severe service, it is made exceptionally strong, rigid and powerful. It is adapted for a wide variety of work and has every aid to rapid handling that long experience has proved practical. Swings 18½ in. over bed—11½ in. over carriage—length 6 feet to 14 feet, as desired. If you want a fast, accurate lathe that will do its work economically, the 18-inch Superior is the machine. **Early deliveries.**

Write for full description.

SUPERIOR MACHINE TOOL COMPANY, Kokomo, Ind.



Our Catalog tells a lot more—send for it.

Uncle Sam Finds This "BRIGGS" Equal to the Demand

Beveling off the corners of axle bushings for 3″ artillery vehicles is one of the jobs at the U. S. Government Arsenal, Rock Island, Illinois, which proved to be too small for a large milling machine and too big for a small one; but just right for the "Briggs."

The milled section is 5/8″ wide and about 1/8″ deep at deepest point; four beveled sections are milled off each bushing; production, 300 bushings per day.

The "Briggs" Miller is a manufacturing machine of many advantages, accurate on all operations, a producer on all work within its range and in a class by itself for power, strength, rigidity and ability to lower costs.

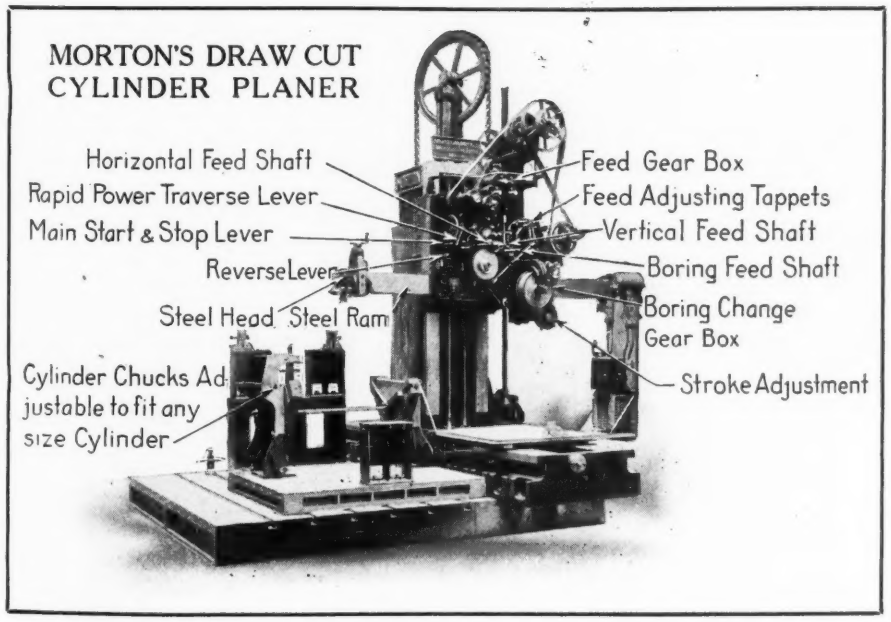
Write for particulars

GOOLEY & EDLUND, Inc.
CORTLAND, NEW YORK

FOREIGN AGENTS: Allied Machinery Co. of America, Paris, Turin, Zurich and Petrograd; C. W. Burton, Griffiths & Co., London, Manchester and Glasgow; Barandiaran, Metivier, Gazeau & Cia, San Sebastian, Spain.

A Profit Maker on Heavy Contract Work

Here's a machine that fairly bristles with good points—features that make it a profitable proposition on work that is often expensive and difficult to machine. The regular Morton Draw Cut Planer action can be quickly changed to a push-cut, converting the machine into a Horizontal Traveling Head Slotter. Built with milling and boring feeds and adjustments, it can handle these operations with ease and speed.

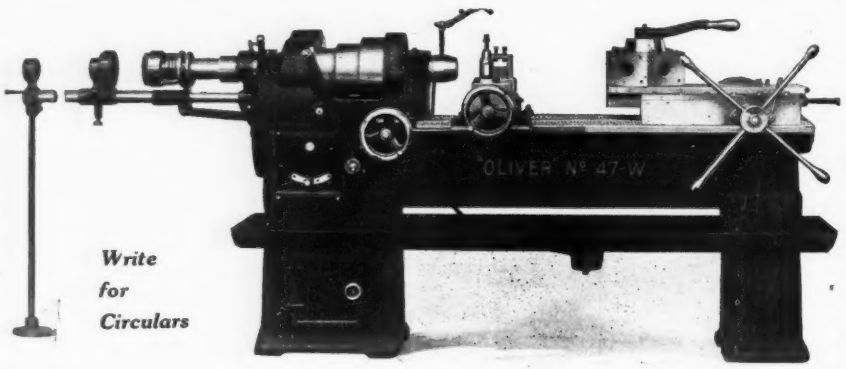


The
Morton Traveling Head Planer

takes but half the floor space and consumes only one-fourth the power required for a housed planer. Several operations can be performed at one setting. It is adaptable for a wide range of work, and in the hands of a skilled mechanic is a machine shop in itself.

BULLETIN No. 8-D FOR FULL DESCRIPTION.

MORTON MANUFACTURING CO., Muskegon Heights, Mich.



Write for Circulars

"OLIVER"

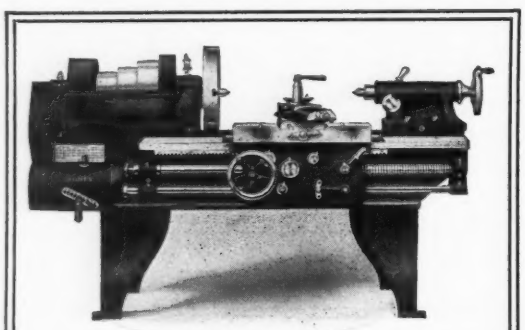
ENGINE LATHES
16"--18"--26"
TURRET LATHES
SCREW MACHINES

Early Deliveries

Oliver Machinery Co.
Coldbrook and Clancy Sts.
GRAND RAPIDS, MICH., U. S. A.

Sidney Lathes

19-inch and 21-inch Swing



Sidney Lathes have been worked out along better than average lines, with the result that service values have more to recommend themselves than is true of less carefully constructed lathes. Sidney Lathes are particularly strong in the wearing parts, and are extra heavily ribbed and braced to maintain accurate alignment and balance under all conditions.

The carriage "V" is larger than usually provided in this type of lathe; the quick-change gear mechanism is of high-carbon steel throughout, and the headstock of the closed type pattern that adapts it especially for high duty.

Complete details on request.

THE SIDNEY TOOL COMPANY
SIDNEY OHIO, U.S.A.

For that reason there are more square inches of wearing surface on the crank bearing of a Kelly Shaper than any other shaper made. You can realize the importance of this point. KELLY SHAPERS are built throughout in the same way.

We Build Them To Wear

They give uncommon service, because they are designed and built with modern shop requirements in view. We have been making good shapers for over a quarter of a century. Catalog describing full line of these efficient cost reducers on request.

THE R. A. KELLY COMPANY
XENIA, OHIO, U. S. A.

Send for circular

NATIONAL LATHES

Meet the demand for a standard quick-change lathe embodying improvements that render it adaptable to a wide range of work in shops where production demands are heavy. Staunchly built, accurately finished. 17" swing.

THE NATIONAL LATHE CO., 15 W. 2d St., Cincinnati, O.

Nos. 1, 2 and 5

Hercules Shears and Rod Cutters

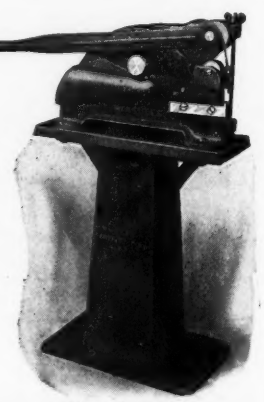
Bring the Work to the Tool or the Tool to the Work

MADE IN 6 SIZES

No. 0 cuts 1-4" iron rod and under, 1-16" flat iron.
No. 1 cuts 1-2" iron rod and under, 3-16" flat iron.
No. 2 cuts 5-8" iron rod and under, 1-4" flat iron.
No. 5 cuts 3-4" iron rod and under, 5-16" flat iron.
No. 3 cuts flat sheets or bar 1-4" or under only.
No. 4 cuts flat sheets or bar 5-16" or under only.

The shear blades have a drawn-in cut, with no tendency to crowd work out of the shear. Note that leverage is directly over the cutting point, also the steel band that raises the jaw, dispensing with all springs.

Send for Shear Catalpgue



Nos. 3 and 4

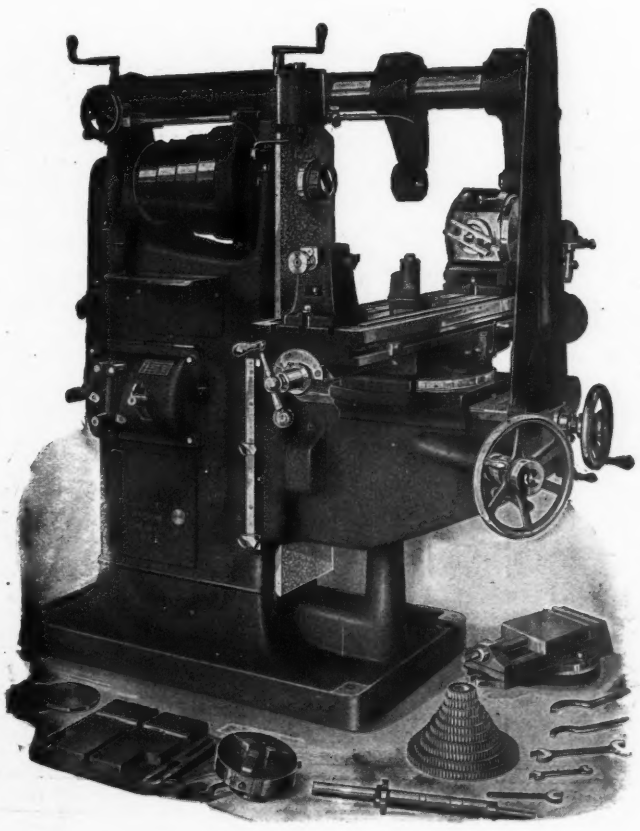
Manufactured and for sale by **W. M. & C. F. TUCKER** HARTFORD, CONN., U. S. A.

A Big "Down East" Concern Bought Four of Our Plain Turning Lathes

and put them to work on shell turning. Three months later we got a long distance 'phone call one morning, asking when we could deliver eight more lathes. *This concern waited six weeks for Hercules Lathes* rather than buy other tools on which immediate delivery could be had.

The Hercules is a plain, heavy lathe which can handle all ordinary turning operations—everything but screw cutting—at maximum feeds and speeds. Simple, rugged, powerful—let us tell you more about it.

Himoff Machine Company
128 Mott Street **New York City**



Quality That Helps Quantity

Buy the machine with a capacity for turning out *accurate* work fast. The combination of these features assures profitable production.

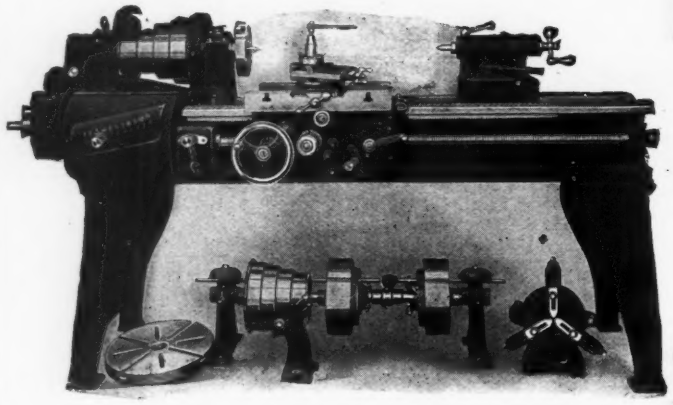
"Ohio" Universal Milling Machines

are compact. Every part works in unison with every other part, making fast work possible, and accuracy is assured by quality, workmanship and excellent materials. Cone steps and back gears are proportioned to give spindle speeds in geometric progression.

For Profitable Milling use the "Ohio"—for grinding, the "Oesterlein" Cutter and Tool Grinder.

Write for details.

The Oesterlein Machine Co.
Manufacturers of
Millers OHIO Grinders
Cincinnati, U. S. A.



Read Our Specifications

Before going ahead get a copy of our specifications of this 14″ engine lathe. It's a

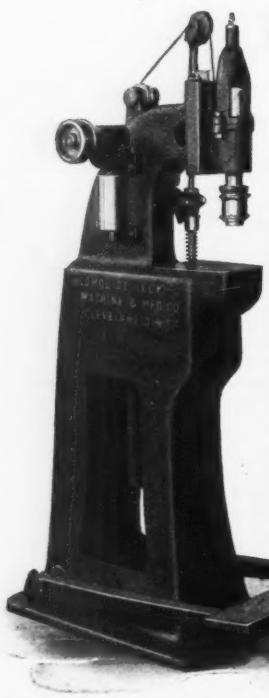
CARROLL-JAMIESON Screw Cutting Lathe

It has double back gears, quick-change gears giving thirty-two changes of feed without removing a gear, nine spindle speeds, 2½″ belt drive from three-step cone.

Drop a line now for a set of specifications.

The Carroll-Jamieson Machine Tool Company
257 Davis Street **Batavia, Ohio**

A Little Brother of its Big Brother —a Money Saver, Too



This No. 2 Pneumatic Riveting Machine

(No. 1 was illustrated in May *Machinery*)

does a number of jobs not adapted to No. 1 Machine and with the same *quality* and *quantity* of production.

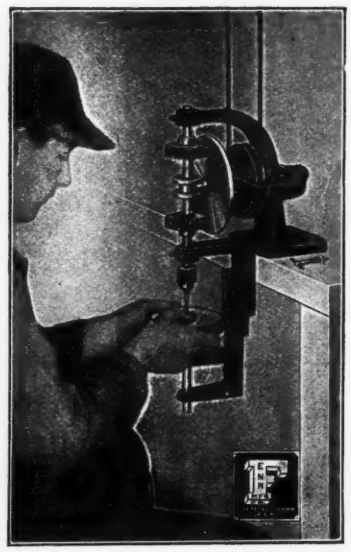
Not a machine for the little job shop—it is a **producer** for manufacturing operations on a large scale where the operator in many cases needs another hand. His foot does the trick very effectively in this design and leaves both hands free to handle the work. Air valve is automatically controlled by movement of treadle.

The hammer of standard make, runs at exceedingly high speed and is of the revolving type, causing the metal to flow easily without distorting the work in places not desired.

Send us blueprints or samples of those parts which you have had in mind for months but for which you could not find the right machine—our production estimate and proposal will surely interest you. Let us tell you more about it. Write us **Today!**

Blomquist-Eck Machine & Manufacturing Co.
203 ST. CLAIR AVENUE, N. E. CLEVELAND, OHIO
AGENTS: E. E. Minard, 516 Free Press Bldg., Detroit, Michigan.

The Fenn Tapping Machine



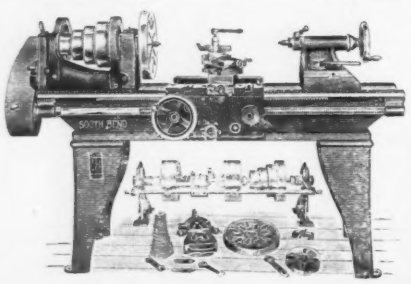
Do your tapping on this machine and save your drilling machines for the work they were built to handle. We can show you it will pay.

A little machine that wins its O. K. on the very first job. Very easy to operate; turns out a large quantity of work economically and with minimum tap breakage. The Fenn has adjustable friction rolls that permit quick speed changes, and can be reversed at higher speed than the forward drive. Capacity 3/16″ holes and under. *Write for full information.*

FENN MANUFACTURING CO.
HARTFORD, CONNECTICUT, U. S. A.
W. L. FENN and W. A. FENN, formerly of Taylor & Fenn Co.
Cable Address: "Fenn"—Western Union Code.

South Bend Lathes

Established in 1906—over 8000 S. B. Lathes in use.



13-inch Lathe
14-inch Lathe
15-inch Lathe
16-inch Lathe
18-inch Lathe

Straight or Gap Beds. For the machine or repair shop.

A low price lathe without expensive fads. Send for catalog and prices.

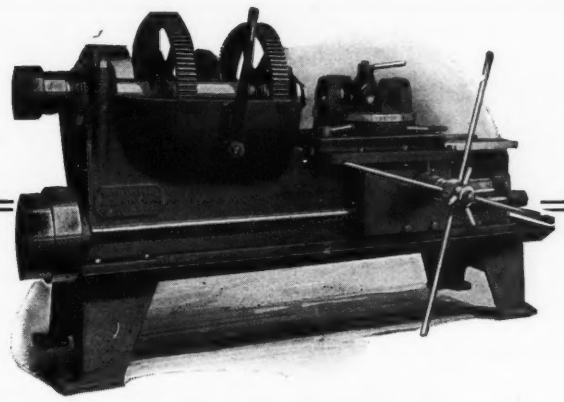
SOUTH BEND LATHE WORKS
426 E. Madison St. **South Bend, Ind.**

STAMPINGS

Dies, Jigs, Tools, Pressed Metal Parts

turned out by us have quality, accuracy, suitable price and positively prompt delivery to recommend them. We furnish estimates from blue prints or samples and solicit trial orders.

Lansing Stamping & Tool Co.
LANSING Dept. D **MICHIGAN**



The Cleveland Chucking Lathe

Does One Thing—Does It Well

This machine was developed for the express purpose of handling the turning, drilling, boring and forming operations on 3″ to 6″ shrapnel and high-explosive shells. Powerful, rigid and surprisingly simple in operation, it can be relied upon to produce maximum output with an unskilled operator. Just the machine to help catch up on those overdue projectile orders. We can make prompt deliveries. Send for circular.

The Cleveland Crane & Engineering Company
WICKLIFFE, OHIO, U. S. A.

ENGINE LATHES
"N.E.A.T."
PRECISION GRINDING

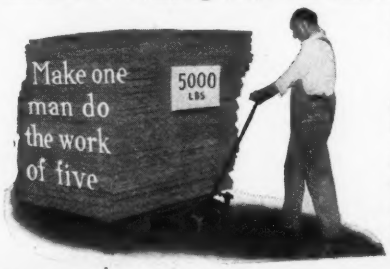
MACHINERY.

TOOLS, JIGS AND FIXTURES

National Engineering And Tool Works
OAK PARK ILLINOIS

Save Handling Expense

Let one man take the place of five. He can do the same amount of trucking with less effort. An actual saving of from 20% to 80% if you use the



Barrett Multi-Truck

Send for our trial offer. We'll demonstrate in your plant that we can save money.

BARRETT-CRAVENS CO.
750 FEDERAL ST. CHICAGO, ILL.

If you tap nuts for automobile construction, or any service demanding good quality, accurately tapped nuts, investigate the

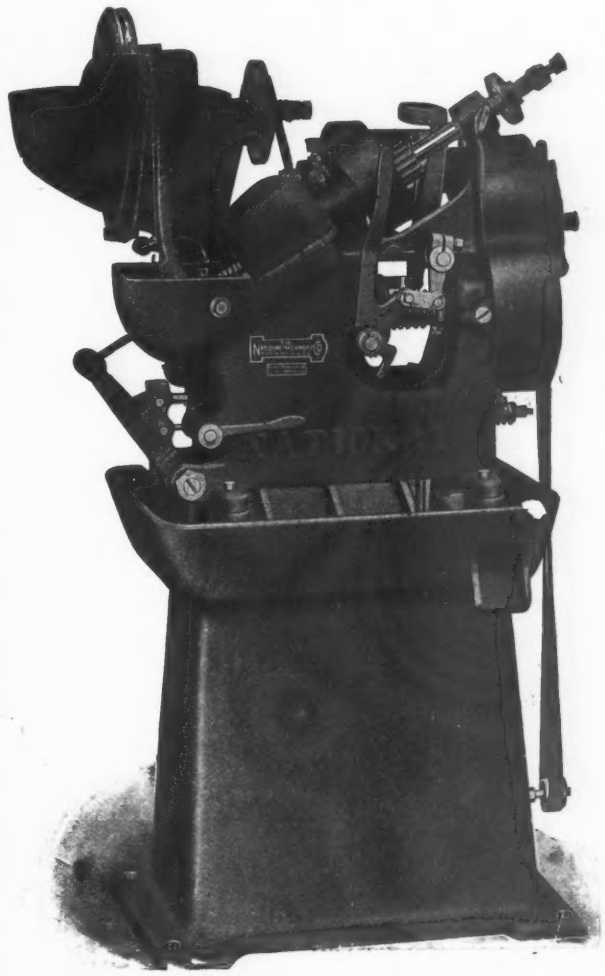
NATIONAL AUTOMATIC (Bent Tap) NUT TAPPER

(PATENTED)

This design embodies radical departures, which greatly improve the tendency to tap nuts "square"—a requisite in good quality nuts.

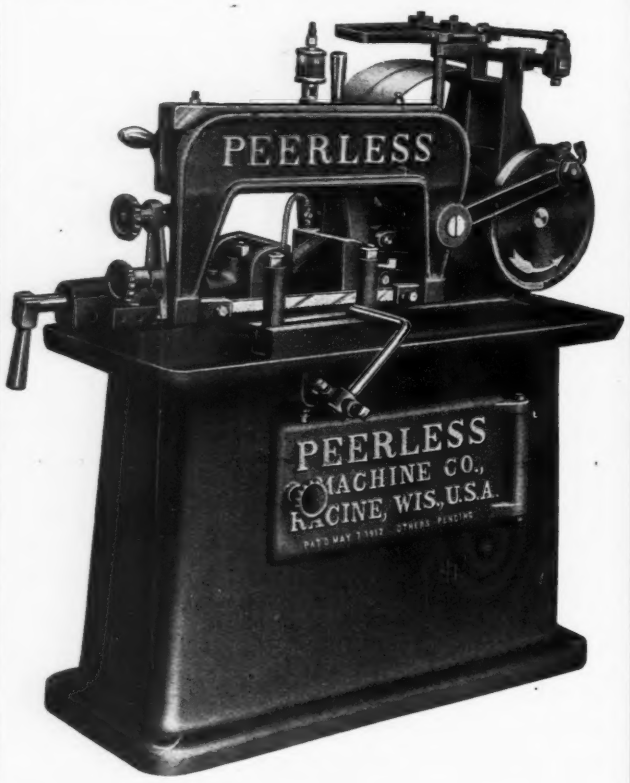
Also, you get bigger outputs; there is less tap breakage; and longer tap life. And, there is decided freedom from trouble and petty repair common in Automatic Tappers heretofore.

We welcome investigation. If you will send samples, we'll advise the possibilities of this tapper on your work, or arrange a test run if you desire. A card will open negotiations.



THE NATIONAL MACHINERY CO.
TIFFIN, OHIO, U. S. A.

National Tapper Talks, illustrating in detail the construction and operation of this tapper, will be sent on request.



Why Does the Peerless Lead?

Because it was designed by the originators of this class of high-speed machinery, and every detail is perfected from real shop experience. It embodies all the latest improvements in this type of machinery, and also some exclusive features that are well worth consideration in selecting a tool of this type.

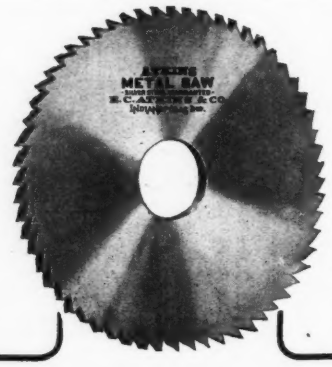
In operation it is semi-automatic, which means it continually saves time instead of wasting it. Just stop to figure—if one man operates ten machines and saves only ten seconds on each cut, in a short time your figures will show a saving in operator's time that will cover the cost of machine.

A saw blade in this machine will cut as much material as in any other machine on the market, and will also cut considerably faster, according to the grade of material.

In order for anyone to appreciate the many labor-saving improvements in this machine, it must be tried out under your own cutting conditions; for this purpose we will gladly send you one on thirty days' free trial.

PEERLESS MACHINE COMPANY

1611 Racine St. RACINE, WIS.



ATKINS

Associate this name with SAWS. We make SAWS for all purposes. Nothing but SAWS and Saw Tools. They are extremely fine SAWS, too. Very many of the largest buyers are using them exclusively and tell us that after comparative test they find them much cheaper in the long run.

Are you using ATKINS SAWS? CIRCULAR, BAND, HACK SAW BLADES or FRAMES? Send for our 248 page book "M." The most interesting Saw Book that has ever been written.

E. C. ATKINS & CO., Inc.

The Silver Steel Saw People

Home Office and Factory, Indianapolis, Ind.
Machine Knife Factory, Lancaster, N. Y.
Canadian Factory, Hamilton, Ont.

Branches carrying complete stocks in the following cities.
E. C. ATKINS & CO.

Atlanta,	Minneapolis,	Portland, Ore.	Vancouver, B. C.
Chicago,	New Orleans,	San Francisco,	Sydney, N. S. W.
Memphis,	New York City,	Seattle,	Paris, France.

The New Mueller "Radial"

Designed to handle a wide range of work and built to maintain accuracy in hard service. Column is stationary and is cast in one piece, arm swings in a complete circle—features found only in this machine—time and labor saving devices are of latest and best design.

The Mueller "Radial" has strength and power equal to the heaviest demand. Don't increase your radial drilling equipment without looking up the "Mueller."

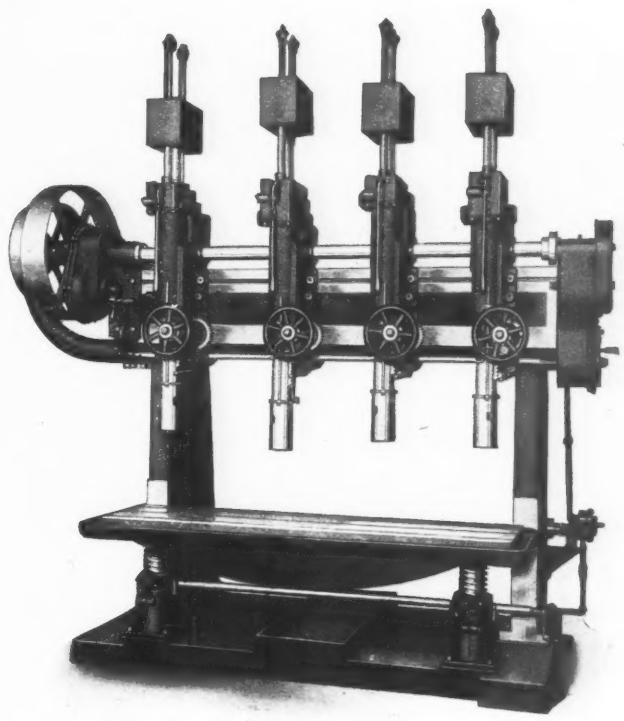
Full description on request.

The Mueller Machine Tool Co.

RADIAL DRILLS AND LATHES

Cincinnati, Ohio U.S.A.

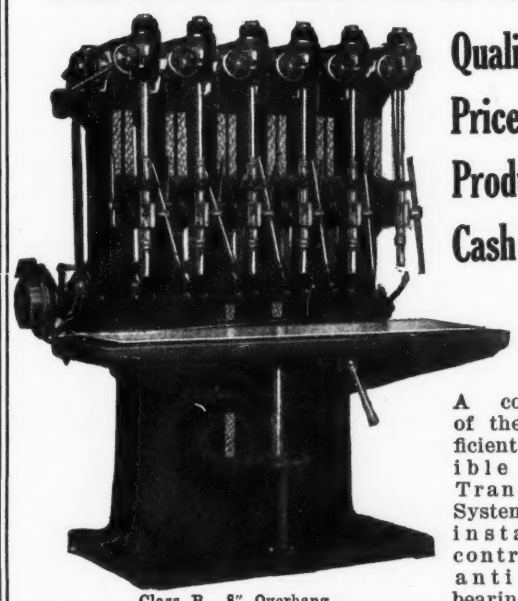
HARRINGTON
MULTIPLE SPINDLE DRILLS



ACCURATE
DURABLE
EFFICIENT
STRONG
and
FAST

EDWIN HARRINGTON, SON & CO.
Incorporated
PHILADELPHIA, PA.

RATHER HIGH



Class B. 8" Overhang

Quality
Prices
Production
Cash Return

A combination of the most efficient and flexible Power Transmission System under instant, easy control with anti-friction bearings, high quality workmanship, design and material with many patented advantages.

252 VARIETIES

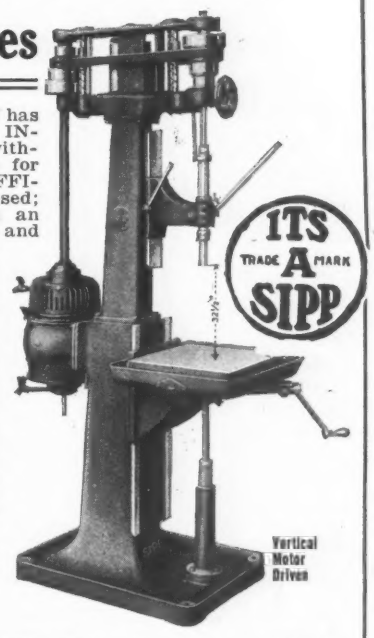
Our largest machines will drill up to 1⅛ inch holes. Our new tapping attachment is now ready for delivery.

THE HENRY & WRIGHT MANUFACTURING COMPANY
760 Windsor Street, HARTFORD, CONN., U. S. A.

DOMESTIC AGENTS: Hill, Clarke & Co., Inc., New York, Boston, Chicago. W. E. Shipley Machinery Co., Philadelphia. Chas. A. Strelinger Co., Detroit, Mich. Colcord-Wright Machinery Co., St. Louis, Mo. Brown & Zortman Machinery Co., Pittsburgh. The Brandes Machinery Company, 715 Marion Bldg., Cleveland, Ohio. Carey Machinery & Supply Co., Baltimore, Md. Coghlin Machinery & Supply Co., Toledo, O. C. H. Wood Co., Syracuse. O. R. Adams, Rochester, N. Y.

The Last Word in Sensitive Drill Presses

SAFETY FIRST DESIGN has four speed changes, INSTANTLY obtained without stopping the machine for each size drill; hence EFFICIENT speeds will be used; and when equipped with an AUTOMATIC chuck, drills and tools may also be changed without stopping the machine. The STRAIGHT BELT transmits full power to the spindle, and belt troubles are NIL. Belt STRETCH is AUTOMATICALLY taken up; the OPERATOR is not required to leave his WORKING position; MINIMUM oiling troubles; spindle SLEEVE is guided rigidly. A SIPP will give you the most wholesome satisfaction. High Grade, High Speed, all Ball Bearing; one to eight spindles. Net weight, single spindle, 925 pounds.



Printed matter on request

THE SIPP MACHINE CO., Paterson, N. J.

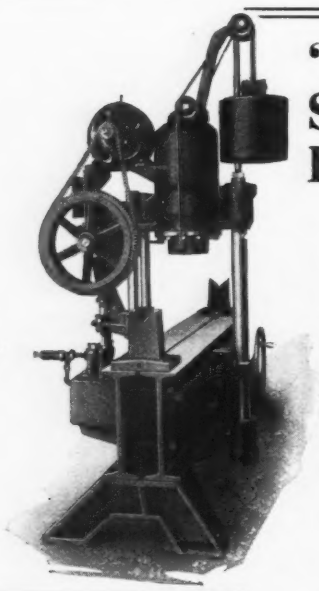
DOMESTIC AGENTS: J. L. Osgood, Buffalo, N. Y. H. A. Smith Machinery Co., Syracuse, N. Y. Peninsular Machinery Co., Detroit, Mich. Niles-Bement-Pond Company of Massachusetts, Boston, Mass. Brownell Machinery Co., Providence, R. I. Purinton & Smith, Hartford, Conn. Barwood-Richards Machinery Co., Bourse Bldg., Philadelphia, Pa. Kemp Machinery Co., Baltimore, Md. Marshall & Huschart Machinery Co., Chicago, Ill., Indianapolis, Ind., St. Louis, Mo. Patterson Tool & Supply Co., Dayton, O. M. Jeager, Engineers Bldg., Cleveland, O. National Supply Co., Toledo, O. Motch & Merryweather Machinery Co., Pittsburgh, Pa. Eccles & Smith, San Francisco, Cal. FOREIGN AGENTS: H. W. Ward & Co., Ltd., Birmingham, Eng., and Milan, Italy. Glaenzer & Perreaud, Paris, France. Iznosskoff, Suckau & Co., Petrograd and Moscow, Russia. Sociedad General De Representaciones, Madrid, Spain. Landre & Glinderman, Amsterdam, Holland. Braum & Co., Stockholm, Sweden.

The "Racine" for Economical Metal Cutting

The "Racine" is the original automatic, positive lift, draw-cut metal cutting machine, with patented lifting device which lifts the blade clear of the work on the non-cutting stroke, thereby increasing output as well as the life of the blades.

It cuts faster, truer and more economically than any other machine of this kind. A broad statement, but one we prove with every sale. We can convince *you*. The machine is compact, rigidly built and stands hard service. Circular on request.

RACINE TOOL & MACHINE CO., 250 15th Street, Racine, Wis.



"Metalwood" Shaft or Axle Bending Press

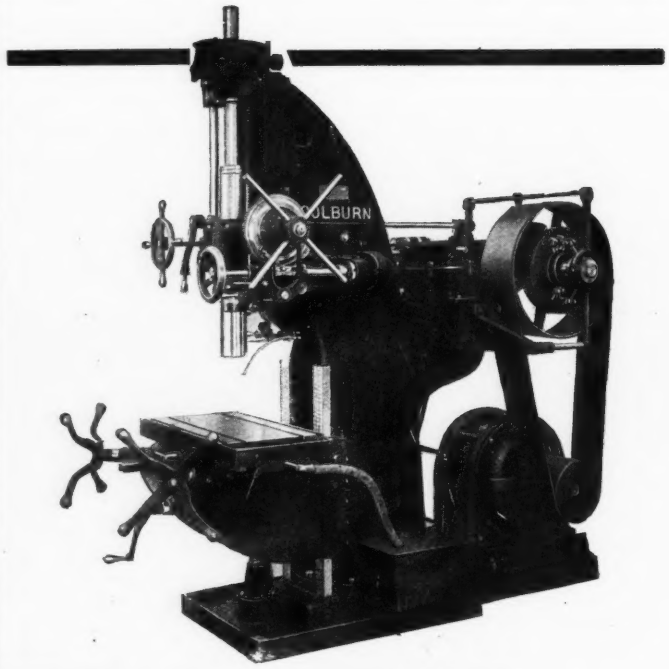
This ruggedly built, well balanced machine has capacity for straightening work up to 6″ diameter on 36″ centers. It is compact and convenient and handles the heaviest work quickly and easily.

Equipped with "Metalwood" Duplex Pump operated by 5 H. P. Motor through a "Link-Belt Silent Chain" drive. The traveling head is carried on roller bearings packed in grease. Operated through compound gearing and so nicely balanced that little effort is required to move it.

Metalwood Straightening Presses are also built in 60- and 90-ton sizes. Furnished with hand-operated, two-pressure, two-plunger pumps when desired. Descriptive circulars on request.

METALWOOD MFG. CO. DETROIT, MICHIGAN

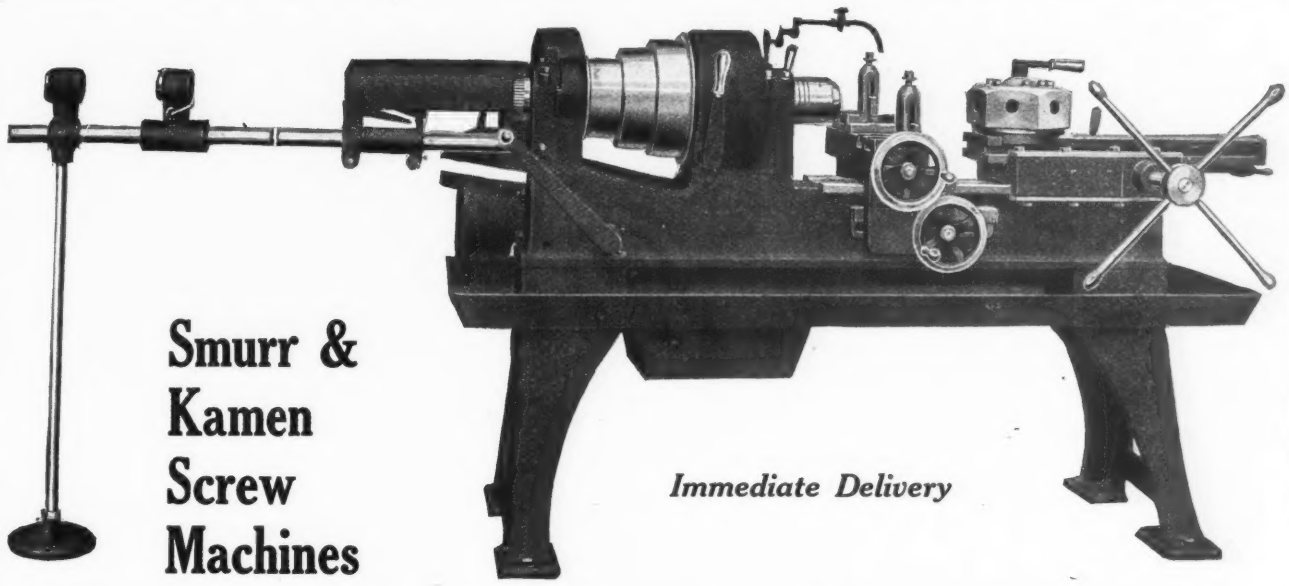
Eastern Office:
PAUL R. KETZER, Eastern Manager, Bourse Bldg., Philadelphia, Pa.



THE "COLBURN"

A heavy-duty drill press of remarkable power, strength and rigidity. Developed to meet the demands of heavy, difficult work, it has unusual range, and can be handled with the ease and speed that plainly spell—profit. It will pay you to write for further details.

COLBURN MACHINE TOOL CO., Franklin, Pa.



Smurr & Kamen Screw Machines

Immediate Delivery

These productive machines are built in four sizes with wire feed capacities from 11-16″ to 1 7-8″. Continuous wire feed eliminates the necessity of push collars. The heavy hexagonal turret is well supported on a wide bearing on the turret slide and upon indexing is automatically clamped and locked. Tools are thus always in perfect alignment with the spindle. Positive independent stops are provided for each tool. Built with either plain or friction geared heads.

We can give you some interesting facts about these handy machines. Let us tell you how they will fit in with your requirements.

YOUNG, CORLEY & DOLAN, Inc., 115 Broadway, New York, N. Y.

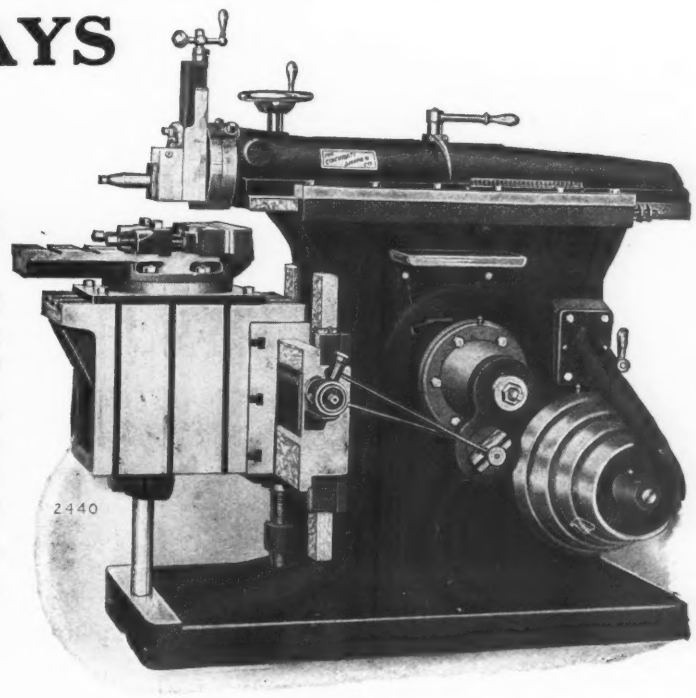
CHILLED WAYS

Are now being made for the Ram Bearing in the Column on all

Cincinnati Shapers

This EXCLUSIVE feature, being used by us, together with SQUARE WAYS with SIGHT FEED OILERS and FULL LENGTH TAPER GIBS endwise adjustable by SINGLE SCREW for taking up wear, are a few of the characteristics that place CINCINNATI SHAPERS in a class by themselves.

Catalog G upon request.

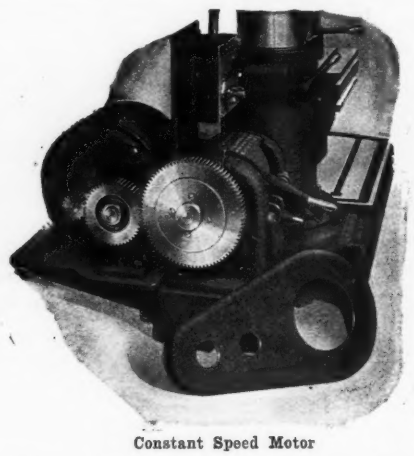


THE CINCINNATI SHAPER CO., Cincinnati, Ohio

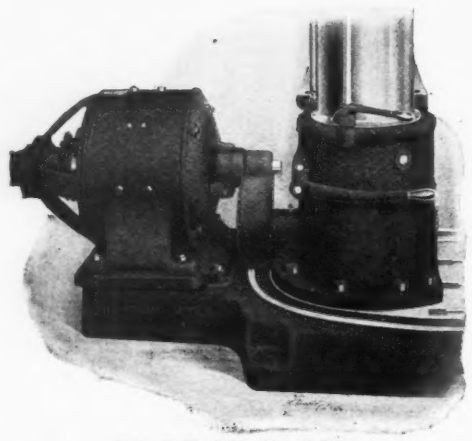
AGENTS: Manning, Maxwell & Moore, Inc., New York, Philadelphia, Chicago, Boston, St. Louis, Detroit, Cleveland, Buffalo, Milwaukee and Mexico City. Brown & Zortman Machinery Co., Pittsburgh. The National Supply Co., Toledo, Ohio. Eccles & Smith Co., San Francisco, Cal. Zimmerman-Wells-Brown Co., Portland, Oregon. C. T. Patterson Co., Ltd., New Orleans, La. Chas. Churchill & Co., Ltd., London, Birmingham, Manchester. Newcastle-on-Tyne. Glasgow. A. H. Schutte, Cologne-Deutz, Berlin, Brussels, Paris, Milan, Barcelona, Bilbao, Petrograd. Donauwerk Ernst Krause & Co., Vienna, Prague and Budapest. McPherson's Proprietary, Ltd., Melbourne, Sydney. Andrews & George, Yokohama.

A Motor Drive May Be Added at Any Time

FOSDICK



Constant Speed Motor



3 to 1 Variable Speed Motor

The "Heavy Duty" Radials are made in five sizes—3-, 3½-, 4, 5- and 6-foot, and the "High Speed Manufacturing" Radials are in three sizes—2-, 2½- and 3-foot. Any one of these machines can be converted to four different standard drives without alteration of base. At any time after purchase you can convert to speed box, constant speed motor, variable speed motor or cone pulley drive.

This is an invaluable asset should you ever desire to sell your radial, or alter your own shop conditions.

Another feature, motors of any speed or any make may be used. *The variable speed motor* is connected by rawhide or cloth pinion, and is thoroughly protected by neat cast-iron gear guard.

The constant speed motor drives through large rawhide (or cloth) intermediate and improved shock absorber gear on speed box, which greatly prolongs the life of both motor and machine.

THE FOSDICK MACHINE TOOL COMPANY, CINCINNATI, OHIO, U.S.A.

AGENTS: Colcord-Wright Machinery & Supply Co., St. Louis; Eccles & Smith Co., San Francisco, Los Angeles, Portland; The Fairbanks Co., New York City, Baltimore; The E. A. Kinsey Co., Cincinnati, Indianapolis; J. L. Osgood, Buffalo; W. M. Pattison Supply Co., Cleveland; Peninsular Machinery Co., Detroit; H. A. Smith Machinery Co., Syracuse; Swind Machinery Co., Philadelphia; Somers, Fitler & Todd Co., Pittsburgh; H. A. Stocker Machinery Co., Chicago, Milwaukee; Taylor Machinery Co., Boston; A. R. Williams Machinery Co., Ltd., Toronto; C. W. Burton, Griffiths & Co., London; Fenwick Freres & Co., Paris, Turin, Zurich; Wynmalen & Hausmann, Rotterdam; Rylander & Asplund, Stockholm; Wilh. Sonesson & Co., Malmo; Russian Metal Trading Co., Petrograd; Roku-Roku Shoten, Tokio; R. L. Scrutton & Co., Sydney.

The Grant Riveter

2,000 RIVETS PER DAY—AND SILENTLY

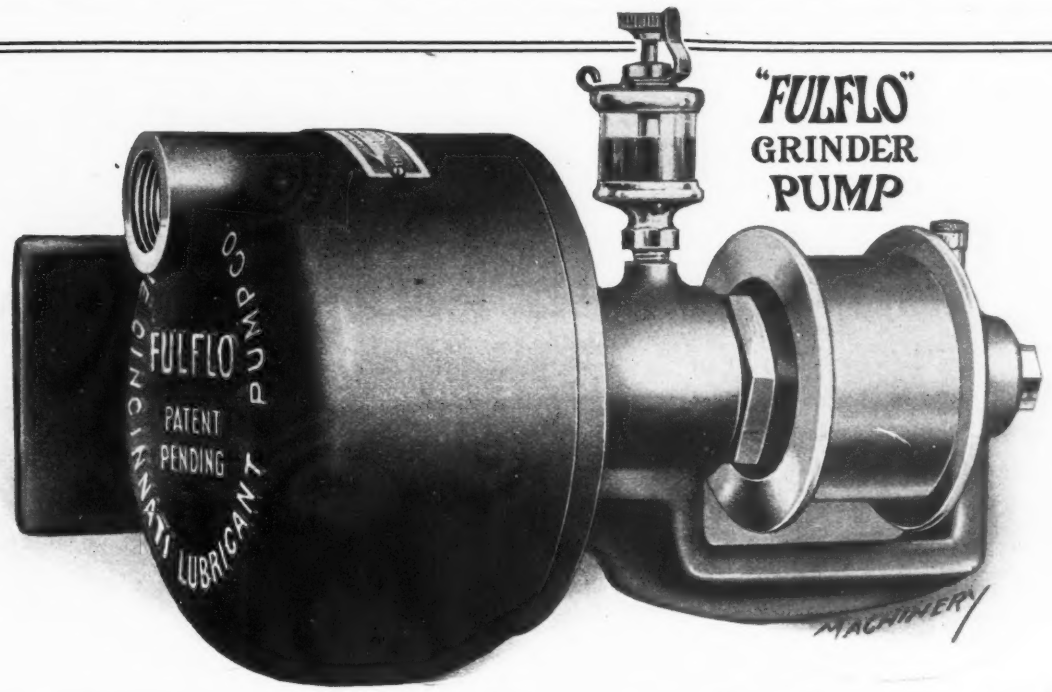
The operator is riveting adding machine key levers, 81 rivets in each machine, and as one operator can do 25 machines in one day of nine hours, this means over 2000 rivets per day for one operator. And all this is accomplished without any noise or inconvenience.

There are seven Grant Riveters in this factory, all of which have been doing satisfactory work for over seven years. No breakdowns—and no repairs have been necessary. This manufacturer is highly pleased with his Grant Riveters, and knows there is no other machine that can so completely meet his requirements.

Where fast production, perfect workmanship and noiselessness are desired, the Grant Riveter completely fills all requirements.

Let us tell you more about it

THE GRANT MFG. & MACHINE CO., N. W. Station, Bridgeport, Conn.

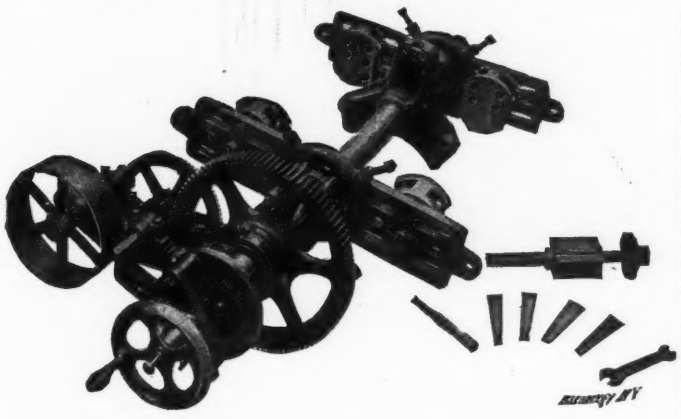


The Pump with the Full Easy Flow

That is one way a "Fulflo" Grinder Pump differs from the ordinary pump—*it doesn't squirt and splash all over the machine and surrounding floor.* Instead, it delivers a large volume of cool lubricant at the point it is needed—the cutting point. Force enough to wash all chips and grit away, but no splash.

The "Fulflo" is centrifugal in action; can be mounted in any convenient position because, on account of its positive trap feature, it will retain its prime regardless of whether it is above or below the level of the liquid. Grit cannot reach bearings nor interfere with action of pump. Complete description on request.

THE CINCINNATI LUBRICANT PUMP CO., 126 Opera Place, Cincinnati, Ohio



Don't Shut Down Your Plant

Even if you must have the engine cylinders re-bored it is not necessary to dismantle the engine and declare a protracted shut-down. If you have an Underwood Portable Boring Bar Outfit, it is an easy matter to refinish the cylinder. Simply take out the piston and start the tool at work and the job is quickly finished. Why have a costly plant stand idle when a small investment will avoid it. There are other profitable uses for the outfit also. We will gladly explain them in detail. Write us.

H. B. UNDERWOOD & CO.

PHILADELPHIA Established 1870 PENNSYLVANIA

We are Oil-Pump Specialists

A Good Flow of Cool Lubricant

is always assured with a Roper Pump. The flow can be varied to meet the requirements of different jobs by the simple method of regulating the cock on the delivery pipe. There are no valves to adjust on

ROPER CIRCULATING OIL PUMPS

The surplus and overflow are automatically taken care of and the flow is kept at a constant pressure. These simple, efficient pumps can be readily attached to any machine. Plain suction and delivery pipes only are required. One-way and reversing styles. Capacities from 4 to 46 quarts per minute. Circulars on request.

C. F. ROPER & CO., Hopedale, Mass.

Building a Wrench to Last

requires knowledge of modern manufacturing practices—of conditions that test the strength and service of any tool.

"Coes" Wrenches have a place in the line with the tools of highest quality—they are not made to look at, but to serve with durability hard to attain in a wrench of any other name.

You can put an end to money wastes that are caused by buying weak-backed wrenches—buy "COES" Wrenches.

This wrench is 30% stronger than others of its type—it's a "COES"—that's why.

The "Coes" Steel Handle Model No. 91 is an **all-metal** wrench designed for use where a wood-handled tool will not do. The bar is hardened steel and cold swaged—the **stiffest bar ever put in a wrench.** The jaw is extra heavy, semi-steel and hardened. Screw is hardened steel and the handle is composed of a semi-steel casting—of patented design. This construction makes the wrench 30 per cent stronger than any other wrench of similar design.

Try a "Coes" Wrench—any one of our models—and note the difference between it and some others you have used. The "Coes" demonstrates its superiority the first time used.

COES WRENCH CO.

Worcester, Mass., U. S. A.

AGENTS: J. C. McCARTY & CO., 29 Murray Street, New York. 438 Market Street, San Francisco, Cal. 1515 Lorimer Street, Denver, Colo.

AGENTS: JOHN H. GRAHAM & CO., 113 Chambers Street, New York. London, E. C., 118-122 Holborn, for Great Britain and Continental Europe.

NICHOLSON Expanding Mandrels

Speed—

this Mandrel gives it!

There is no delay, no hesitancy, no doubt, when you use this mandrel. There is no measuring, no calipering. You are always positive that it will fit perfectly. The principle on which the Nicholson is built—and that it is appreciated and fully understood is evidenced by the huge number of shops that have made it a standard tool—does not allow of doubt or imperfect fits. The tapered grooves in the arbor, the corresponding tapers in the jaws, give an infinite range of sizes between the limits of the mandrel.

We will gladly loan you one of these high-speed mandrels for test. Send for yours today. No obligation.

W. H. Nicholson & Co.
112 Oregon St. Wilkes-Barre, Pa.

Complete line described in catalog

Gerstner Tool Cases

Are the choice of workmen who appreciate orderly methods and good workmanship. "Gerstners" are practical in design, light in weight, but very strong and durable; are handsomely finished and unsurpassed for convenient arrangement.

L. Gerstner & Sons. 11-21 Columbia St., Dayton, Ohio

Wear-Ever Spacing Collar

Saves Time in Setting Up Milling Cutters

Don't waste time picking out and measuring spacing collars. Use a "Wear-Ever" and get the *exact* spacing instantly. Twelve adjustments of 0.002" each. Doesn't lose its accuracy through wear. For a quick milling set up, the "Wear-Ever" is the logical collar to use. Write for circular.

SCULLY-JONES & COMPANY

647 Railway Exchange Building
CHICAGO U. S. A.

MADE BY EXPERTS

It takes a highly-efficient organization, with every modern mechanical facility at its command, to produce Die-Castings which will be uniformly satisfactory. Possibly there is no other branch of the foundry business which requires greater skill and longer experience.

Such an organization is behind

ACME DIE-CASTINGS

Every member of the organization is an expert at the business. The Acme Die-makers are the best and highest paid men in their line. The chief engineer, who oversees every detail of your work, knows the business so well that he has been able to invent and perfect the wonderful Acme Die-Casting Machines which produce a larger quantity per hour of perfect die-castings than any others in existence.

From the Acme Laboratory you will get the toughest, most homogeneous, velvety-grained metals for this purpose possible to obtain. Metals that remain constant in formula.

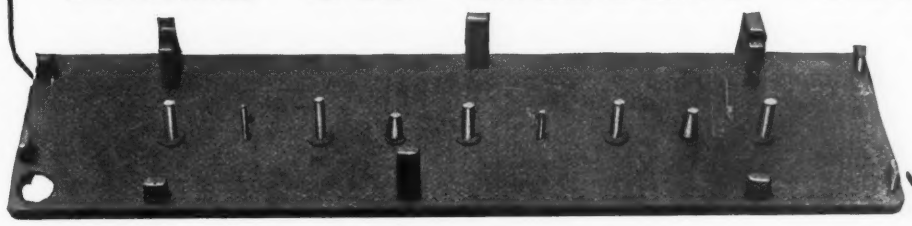
And from the Acme organization you get *deliveries*, when you want them and how you want them.

That is the kind of service you have a right to expect when you negotiate for the purchase of die-castings.

It's the kind of service we give you—a service so closely in touch with *your* requirements that our factory virtually becomes a department of *your own* business, ready at all times to meet or anticipate your needs, no matter how severe they may be.

We solicit correspondence with manufacturers who wish to realize the remarkable possibilities of die-casting economies.

ACME DIE-CASTING CORPORATION



BUSH TERMINAL BUILDING No. 5
35th Street and 3rd Avenue
BROOKLYN, N. Y.

SALES OFFICES:
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PHILADELPHIA—Widener Bldg.
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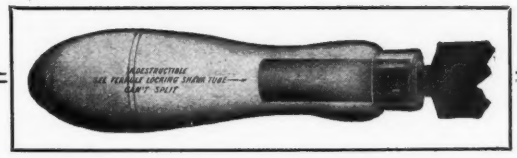
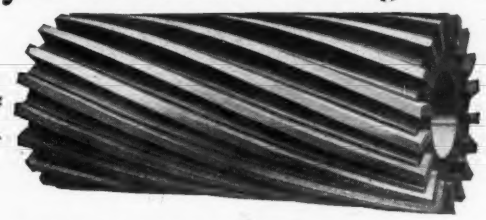


A Really Good File Handle

The Osgood File Handle never splits. The steel tube on the inside takes all the strain of the tool and holds it securely at the same time. So reasonable in price you can't afford to be without it. A trial brings proof—samples free to dealers and manufacturers; eight cents each to individuals.

J. L. OSGOOD TOOL COMPANY
43-45 PEARL STREET BUFFALO, N. Y.

Taylor-Newbold Milling Cutters



For Service—Utility—Strength—Power
4 in. DIAMETER FOR GENERAL USE

Write for Bulletin R-P

THE TABOR MANUFACTURING CO.
PHILADELPHIA, PA., U. S. A.

Oxy-Acetylene Welding

In the manufacture of metal goods this method for making strong, smooth joints is being adopted so rapidly that we have our hands full keeping up with the orders.

It costs less and makes a stronger, smoother union of metals than any of the old ways of riveting or pressing together.

Send for Booklet.

K-G WELDING & CUTTING CO., Inc.
556 W. 34th St. New York City
'Phone 6358 Greeley

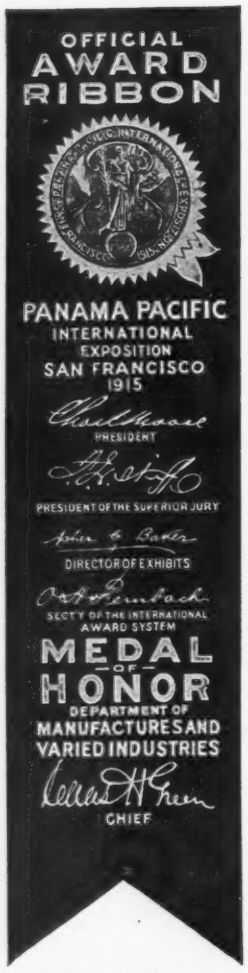
Engine Lathe to Turret Lathe in 15 Seconds—Cost, Trifling

Attach a *Newman* Multiple Rotary Chuck to the tailstock of an engine lathe—presto—you have all the advantages of a practical turret lathe. Handles the odd jobs, where it doesn't pay to set up a turret lathe, with surprising speed and economy.

Drills, counterbores, reams, taps, etc., without changing tools. Try it for 30 days free. Write for our Bulletin M.T.

We also make Tool Post Turrets and Drill Press Turrets

NEWMAN MFG. COMPANY
717 Sycamore Street CINCINNATI, OHIO



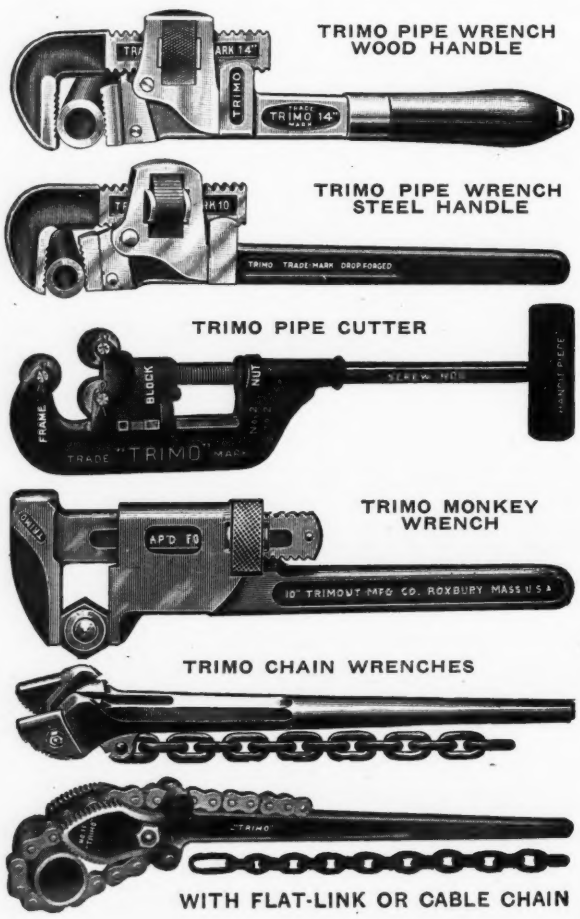
TRIMO TOOLS

Nut with Nut Guards

BE sure to ask for the Trimo Wrenches, both Pipe and Monkey. They are equipped with Nut Guards that prevent the accidental turning of the adjusting nut in close quarters, and in the principal sizes with Steel Frames that will not break.

Send for Catalog No. 38

Trimont Manufacturing Company
55-71 AMORY STREET
ROXBURY, MASS., U.S.A.



Need a Set of Figures?

To prove that S & L steel stamps, as a result of 20 years' experience, have unusual qualities to recommend them, we will send you a set of figures 1/16, 3/32 or 1/8", prepaid, for $1.50. We feel it's merely a question of your trying them—after that we will not have to sell them—you'll *buy* them.

S & L stamps are made of the best stock, carefully treated by experts to stand the knocks. It'll pay to investigate.

Catalog for full details

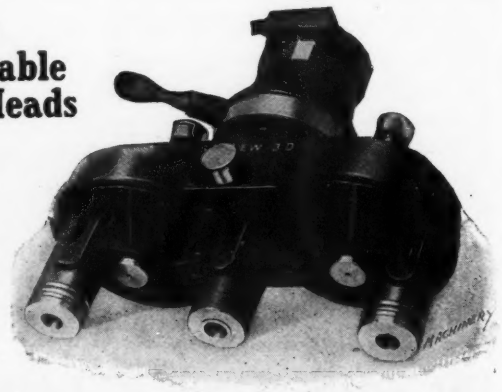
SCHODER & LOMBARD STAMP & DIE CO.
INCORPORATED
Canal and Lafayette Sts., NEW YORK CITY

Sellew Adjustable Drill Heads

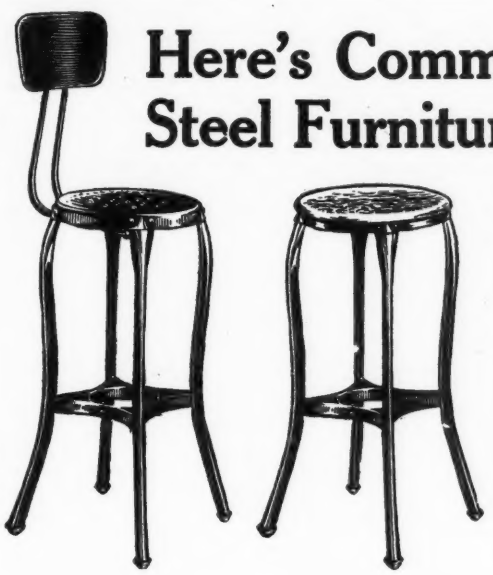
Save Money

Three Holes at once instead of one

Write for details.



SELLEW MACHINE TOOL CO., Pawtucket, R.I., U.S.A.



Here's Common Sense Steel Furniture

UHL Steel Tool Trays and Steel Factory Stools

Construction is a safe guide to service in factory furniture. You wouldn't buy upholstered stools, for instance. **UHL Steel Stools** are sensible stools; they give life-time service, never break, and really cost less than other stools, because replacements are unnecessary.

Write us for prices and circulars.

UHL Steel Portable Tool Trays are just as sensible in *their* way, and give practically double service, as the trap can be reversed to form a smooth, level table top when desired. Constructed of pressed steel, they are considerably lighter than cast-iron trays, are mounted on strong, easy-running 3″ steel wheel casters, and can be furnished in various combinations.

THE TOLEDO METAL FURNITURE COMPANY

3309 DORR STREET **TOLEDO, OHIO, U. S. A.**

The "Boehm" Die Head

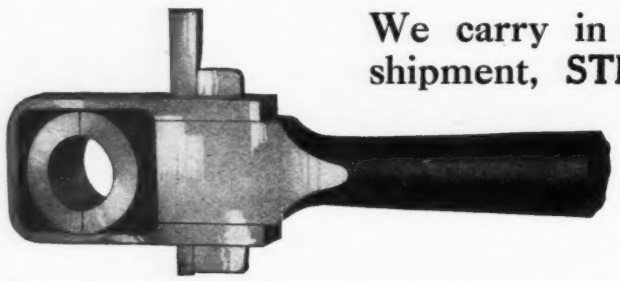
The Two Locking Pins

No cramping strain on the die when two locking pins are used—nor can the die catch on one pin and spring out of size or cut a poor thread. *Important points, these.* Also floating the lock on two pins in this manner provides a means of compensating cutting pressure when the spindle on which the Die Head is used is not in exact alignment with the work.

The catalogue explains this and other features of the "Boehm" Die Head fully. Let us send a copy. (See also the next issue of MACHINERY).

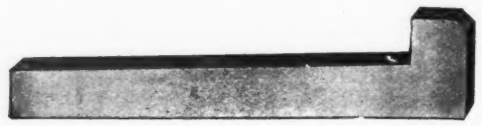
Rickert-Shafer Co.

612 West 12 St. Erie, Pa., U.S.A.



We carry in stock, usually ready for immediate shipment, **STRAP JOINTS** in 63 standard sizes.

We will appreciate your inquiries.



We make **CONNECTING RODS** smooth forged or finished, also Straps, Wedge-blocks and all kinds of Bearings either finished or in the rough.

We make Finished Machine Keys and all kinds of Special Keys. Can now make very quick deliveries.

WM. E. LEARD, New Brighton, Pa.

SIMPLEX SEAMLESS STEEL TUBING

BRASS — COPPER — BRONZE
NICKEL–ALLOY–ALUMINUM

Screw Machine Products, Springs, Metal Stampings, Tungsten Hack Saw Blades

C. R. Strip Steel Anald. and Tempered Spring Steel, Tool & Alloy Steels, Magnet Steel

STEEL—BRASS—BRONZE BALLS

IMMEDIATE STOCK SHIPMENTS

PROMPT MILL SHIPMENTS

Cold Drawn
Screw Steel Shafting
Cold Drawn Flat and Special Shapes

JULIUS BLUM & COMPANY

510-512 West 24th Street, New York
Branches: Philadelphia, Buffalo, Cleveland, St. Louis, San Francisco, Seattle, Los Angeles, Calumet, Mich.

SHAFTING

ALLEN
INSTANTANEOUS
WATER COOLERS

Stock sizes to hold 25, 50, 100 or 200 pounds of ice. Prompt shipments.

Write for folder on "Drinking Water Coolers That Save Money"

THE ALLEN FILTER COMPANY, Toledo, Ohio, U. S. A.

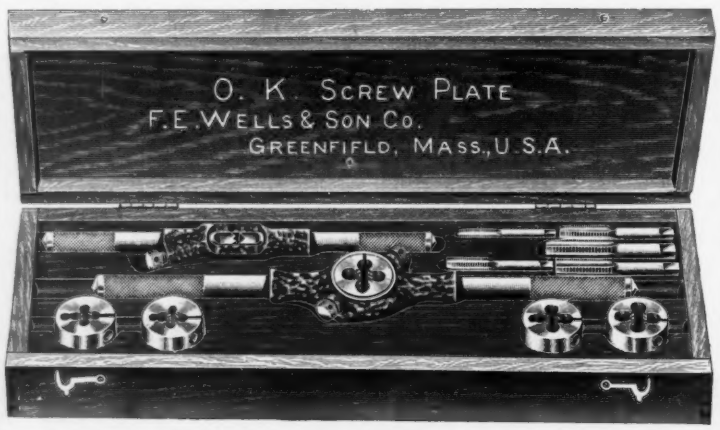
Almorth Practical Drawing Table

$9.50—Guaranteed

Any Board Fits It

ONE hand-nut adjusts to any angle. Thoroughly rigid; very simple. Two foot rests; plenty of leg room. Price for castings, hinges, cabinet brackets and B/P to make tie rods, etc., $9.50. Everything except board and cabinet, $13.25. Complete, with best white pine board, 30" x 42" x ¾", $17.00. Other sizes if desired. If three-drawer cabinet is wanted, add $8.00. Order while prices are low. Send for folder.

G. A. ALMORTH
964 Grand Ave.
NEW HAVEN CONN.



O. K. Screw Plates and Dies

Are designed to secure great strength with minimum weight. They are hammered from flat bar steel and subjected to our special hardening treatment which insures exceptional toughness and durability. Plenty of room for oiling and chip clearance insures smooth, accurate threads and ease in operation.

Catalog 7-A for full details.

F. E. WELLS & SON CO.
GREENFIELD MASS., U. S. A.

EAGLE
SAFETY SET SCREWS

It's All in the Way they're Made

We might have made the hole in the Eagle Hollow Safety Set Screw a different shape, but we didn't—because the square hole provides the greatest advantages for strength and economy.
We might have made the Screws of ordinary steel but every Eagle Set Screw is made of specially hardened bar steel. Eagle Set Screws never bind or jamb, stand all strains, and meet mechanical requirements as well as those of safety.

If you are interested, let us send you samples for a trial—be sure to mention size.

Catalog on request

THE PROGRESSIVE MANUFACTURING COMPANY, TORRINGTON, CONN.

CAMDEN

These men are sitting on a

CAMDEN FORGING

which everybody concedes to be a big one, and they are holding what is fairly termed a little one, which goes to show the variety of work we put through our shops. We can make forgings and make them right. We'll rough it out or completely machine it if you wish. We can help you, as we have helped hundreds of other concerns with their forging problems.

Let's talk it over and show what we can do for you

Camden Forge Co.
8th & Bulson Ave.
Camden, N. J.

Forgings
As Large or as Small as You Need Them

FAFNIR BALL BEARINGS

How About Your Ball Bearings

Look to the equipment of your machines. Where endurance and dependability are essential features in the make-up of any mechanism, you will always find Fafnir Ball Bearings applied.

No better bearings are made

THE FAFNIR BEARING COMPANY

CONRAD PATENT LICENSEE

DETROIT OFFICE:
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MAIN OFFICE AND FACTORY:
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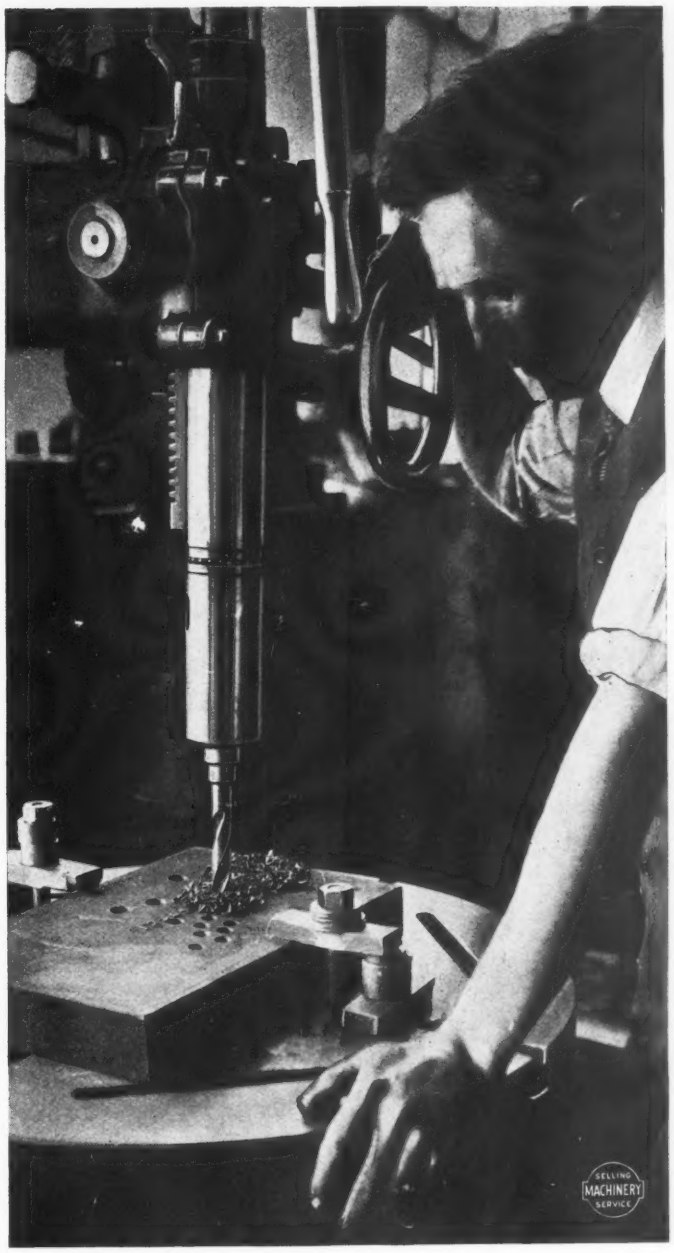
CHICAGO OFFICE:
39 S. CLINTON STREET

Heat Treated Carbon Steel Drills—



VINCENT
DETROIT

A Story Worth Reading

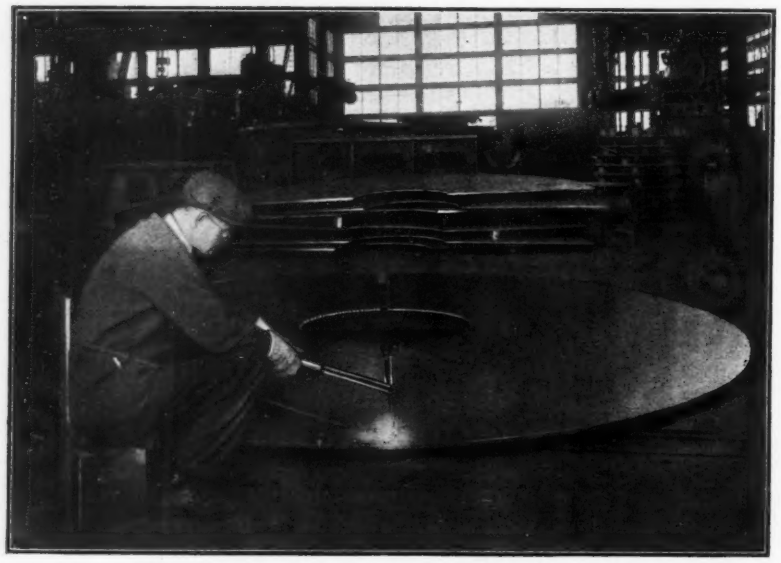
The National Automatic Tool Company, Richmond, Indiana, asked us a few weeks ago if we could heat treat a carbon steel drill and what could be expected from a drill so treated. We answered by asking the Natco people to send us any drill they wished to experiment upon; we to heat treat it and they to test it out. We have just received the figures—they may interest you. Supt. Baker (Natco) set up the drill as soon as it reached Richmond and conducted the tests himself. The test blocks were cast iron, 0.2″ thick, the drill ¾″, speed 267 R. P. M., feed 0.018″. At the time the photograph was taken this drill had completed 10 holes and showed no signs of wear whatsoever.

We are now heat treating more drills for Natco, orders which are proof positive that this concern is satisfied.

Our cards are face up on the table—no tricks to pull off. We know how to heat treat all manner of work and are doing great quantities of it for concerns everywhere. We do it economically because we do it right—without waste. May we do something for you?

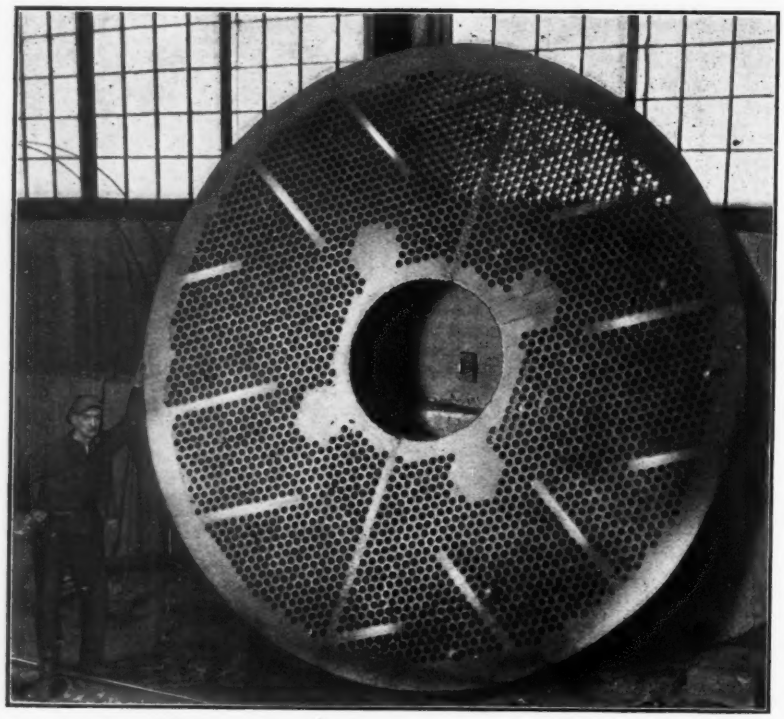
VINCENT STEEL PROCESS COMPANY

751 Bellevue Avenue **DETROIT, MICHIGAN**



Welding a Big Job Requires Dependable Apparatus

Davis-Bournonville Welding Apparatus



The Treadwell Engineering Company, Easton, Pa., had a contract for tube sheets for sugar mills. Specifications called for ¾″ sheet ingot iron, 13 feet in diameter. Single sheets of this size could not be obtained so two half sections were welded together.

It was an out of the ordinary welding job—a 13-foot weld—and once the weld was started it had to be kept up until the piece was completed, because allowance had been made for expansion.

Davis-Bournonville equipment was selected and for six hours on each piece it gave a steady, even flame, without over-heating or fluctuating—a satisfactory record on a difficult job.

If your welding requirements are exacting there is every reason why you should use Davis-Bournonville apparatus. Consider it from the viewpoint of safety, economy, dependability and positive results and you will find a host of superior features. Give us a chance to show you.

DAVIS-BOURNONVILLE CO. DAVIS APPARATUS NEW YORK - CHICAGO

Leads the world in range, efficiency, and number of outfits in use.

DAVIS-BOURNONVILLE COMPANY

NEW YORK — General Offices and Factory: Jersey City, N. J. — CHICAGO

Sales Offices: New York Chicago Detroit Cleveland Pittsburgh Philadelphia Boston

Highest Quality Ferro Tungsten

Do You Analyze Your Ferro-Tungsten?

If Not, It Would Pay You To Do So—

The value of a product is largely controlled by the purity of the materials of which it is made.

We Guarantee —
Our Ferro-Tungsten to this analysis:

Tungsten	70 to 80%
Carbon—not over	.½%
Sulphur—not over	.05%
Phosphorus—not over	.08%

Our facilities are of the very best due to a strictly modern plant and equipment. We are able to offer quick deliveries. Write, Wire or Cable for prices.

THE VANADIUM-ALLOYS STEEL CO.
LATROBE, PENNA.

Makers of "Red Cut Superior"—A Quality High Speed Steel

Your *Business no doubt is Booming* and every second of time saved means an increase in Production and Profits!

This you can accomplish by using the

"Wiard Quick Change Chuck"

The Wiard saves Time, Temper, Tools and Fingers. It does not flop; it does not slip, nor wobble; but, it does change quicker than any other Chuck and runs absolutely true. Because it is built on correct mechanical principles.

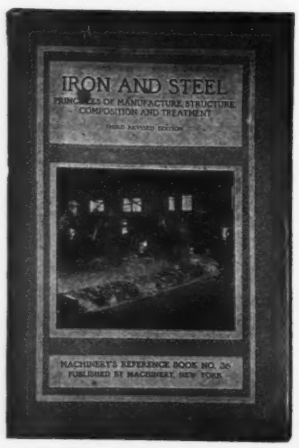
All parts are properly hardened and finished.

If your factory is not equipped with the "Wiard Quick Change Chuck" send us a sample order and then compare by its use the time you will save and the quality of workmanship your mechanics will produce.

Manufactured by

The Eclipse Interchangeable Counterbore Company, Inc.

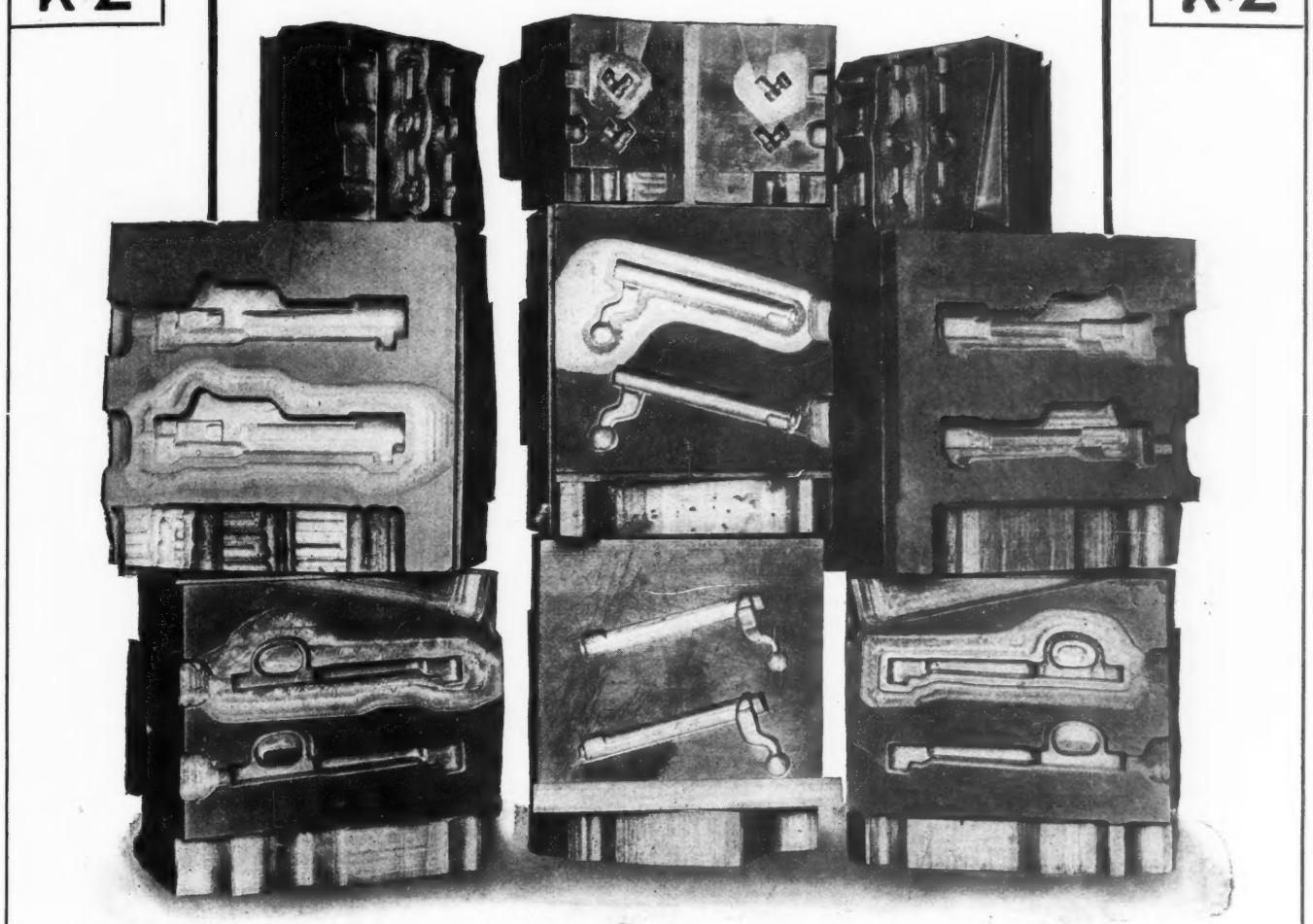
DETROIT U. S. A.


IRON AND STEEL
PRINCIPLES OF MANUFACTURE, STRUCTURE, COMPOSITION AND TREATMENT
MACHINERY'S REFERENCE BOOK NO. 36
PUBLISHED BY MACHINERY, NEW YORK

IRON AND STEEL

This book, No. 36, MACHINERY'S Reference Series, graphically describes the processes of manufacture of iron and steel, from the time the iron ore is mined until it is ready for the market. It is written in a practical way and is extremely interesting even to anyone who is not directly engaged in the production of iron and steel. The process of making pig iron from the ore and the development of this pig iron into the various sorts of iron and steel are described briefly and clearly. The difference in composition of the different steels is shown, and there is a discussion of the steel-hardening metals and their effects on steel. A book you need—**25c a copy.**

Published by MACHINERY, 148 Lafayette Street, New York



These Drop Forge Dies were made on a Keller Automatic

Do you realize what automatic die sinking means to the Drop Forge Industry?

Tell us your problem—we'll be glad to give you the benefit of our experience.

KELLER MECH. ENG. CO., New York
70 Washington Street, Brooklyn

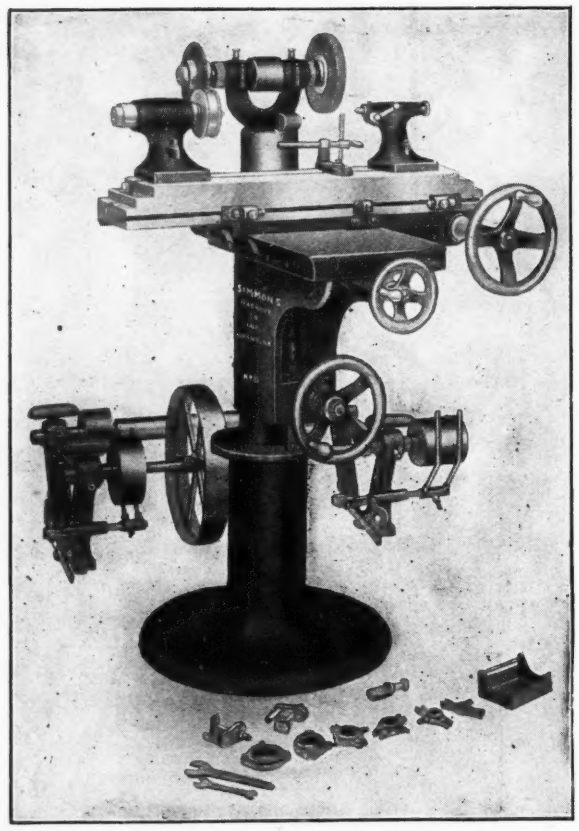
Alfred Herbert, Ltd., Agents for England (Coventry), France (Paris) and Italy (Milan)

Need a Tool Grinder?

Look This One Over

It has features which recommend it —the large diameter of the column, for example, also the length of the column bearing, the heavy construction of both head and tail stock, our improved double countershaft, the convenient location of all handles within the natural working position of the operator.

These features all contribute to the speed and accuracy with which work can be handled. Range covers all tool and cutter grinding and similar work. Write for the circular.



902 Singer Bldg. New York City **SIMMONS MACHINE CO., Inc.,** 985 Broadway Albany, N. Y.

The TURNER TURRET

Pays even on Short Run Work

A Turner Turret is profitable on runs of work shorter than most machines can be set up for *because the tooling is simple and easily applied.*

Consider the job shown herewith, for instance. These parts are slides for lathe carriages. There is drilling on five faces of the work, the holes ranging from 1/4" to 7/8" diameter; there are reaming and tapping operations also—seventeen operations in all. All that was required in the line of special tools was the jig. Two spindles are used for the two largest drills and the smaller drills are used as needed in the other two spindles.

Let us tell you more about the Turner Turret and its advantages—the machine of "Drill Press Simplicity—Turret Lathe Output."

TURNER MACHINE COMPANY

DANBURY, CONN. and Newark, N. J. U. S. A.

Incorporated with Turner, Atherton & Co., Ltd., Denton, Manchester and Stockport, England.

IT IS NOT THE MAN

Today, it is not the man who gets results. The most expert machinist gets NOTHING from a poor machine. But put a man, even with little experience, on a good lathe and watch the work fly.

CISCO'S DO NOT REQUIRE EXPERTS

Even a boy can operate them. They are so simple in operation, yet so thorough in efficiency, requiring only ordinary caution in running. Powerful and satisfying, giving the boss just what he's looking for:—ACCURACY, EFFICIENCY, ECONOMY; and that's why YOU buy

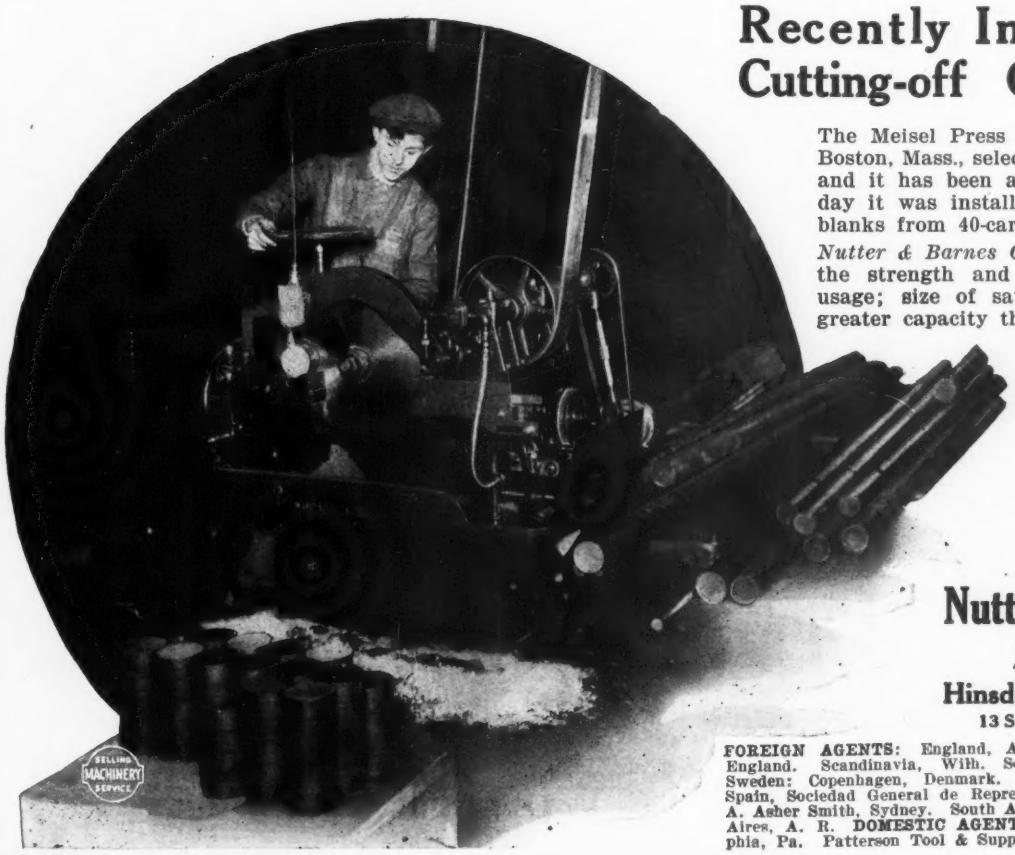
THE LATHE WITH THE PULL

THE CINCINNATI IRON & STEEL COMPANY, Cincinnati, U. S. A.

14", 16", 18", 24" LATHES

Nutter & Barnes Saw

Recently Installed for Cutting-off Gear Blanks



The Meisel Press Manufacturing Company, Boston, Mass., selected this *Nutter & Barnes*, and it has been a busy machine from the day it was installed, cutting off 3⅝" gear blanks from 40-carbon steel.

Nutter & Barnes Cutting-off Machines have the strength and rigidity to stand hard usage; size of saw considered, they have greater capacity than any similar machine. They not only cut fast, but they cut accurately. They are standard machines which, with the addition of inexpensive fixtures, can be used on work not usually handled on machines of this type. Let us tell you more about them.

Nutter & Barnes Co.

The Metal Cutting-off Machinery Specialists

Hinsdale, - - N. H.

13 South Clinton Street, Chicago

FOREIGN AGENTS: England, Alfred Herbert, Ltd., Coventry, England. Scandinavia, Wilh. Sonesson & Co., Ltd., Malmo, Sweden: Copenhagen, Denmark. Russia, C. Schinz, Petrograd. Spain, Sociedad General de Representaciones, Madrid. Australia, A. Asher Smith, Sydney. South America, A. G. Burbanks, Buenos Aires, A. R. **DOMESTIC AGENTS:** Swind Mchy. Co., Philadelphia, Pa. Patterson Tool & Supply Co., Dayton, Ohio.

The Earle Single-Purpose Lathe

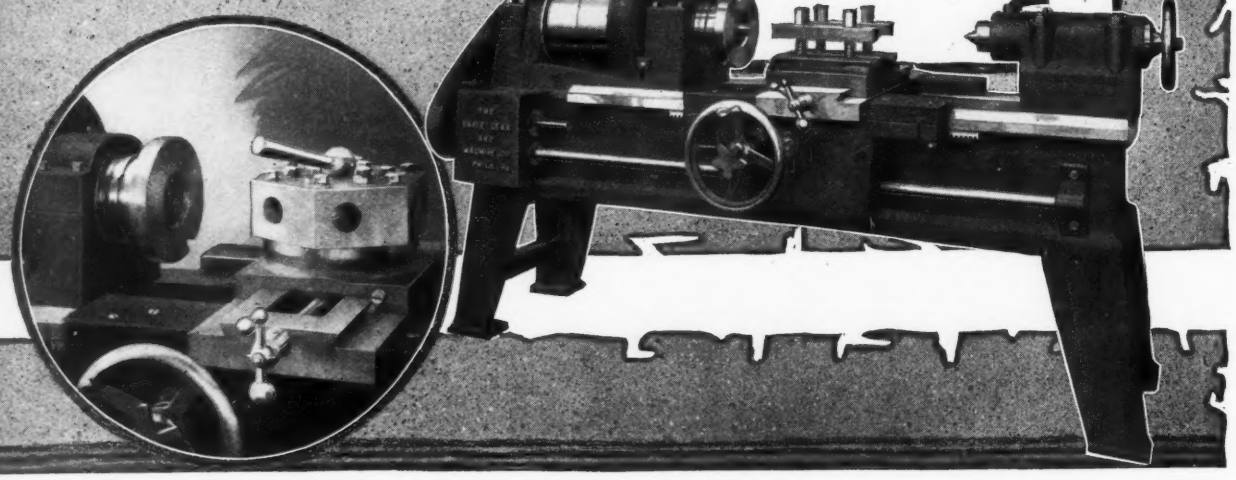
FOR plain turning in high-output manufacturing, these 18″ high-duty, back-geared lathes, with 6″ belt capacity and quick-change feed box, are replacing 24″ machines, because they have practically equivalent cutting capacity.

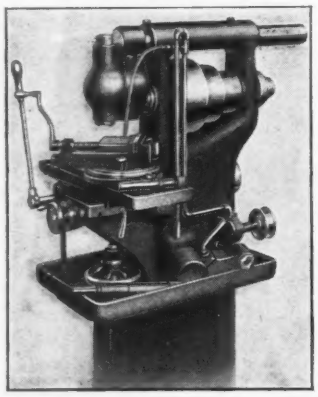
Frequently they are fitted with turrets for boring.

We have an interesting folder analyzing the manufacturing possibilities of these lathes.

May we mail you your copy now?

The Earle Gear & Machine Co.
105 East Wyoming Avenue
Philadelphia





The
BICKFORD MILLING MACHINE

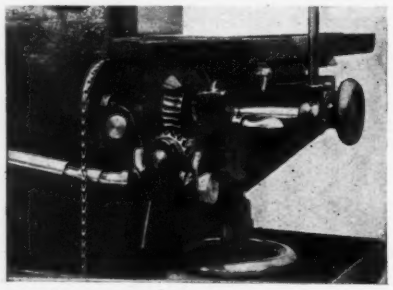
among its many advantages has one that eliminates chatter and vibration in cutting. It is

Something New in a Rack Feed

By using a quarter section screw as a rack we have a simple mechanism which gives a smooth, direct drive. This machine is unequaled for producing small and medium size duplicate parts. Simple, speedy and handy. Vertical attachment takes power direct from spindle. A weight returns the table when cut is finished.

Send for further information

Bickford Machine Company
Greenfield, Mass.



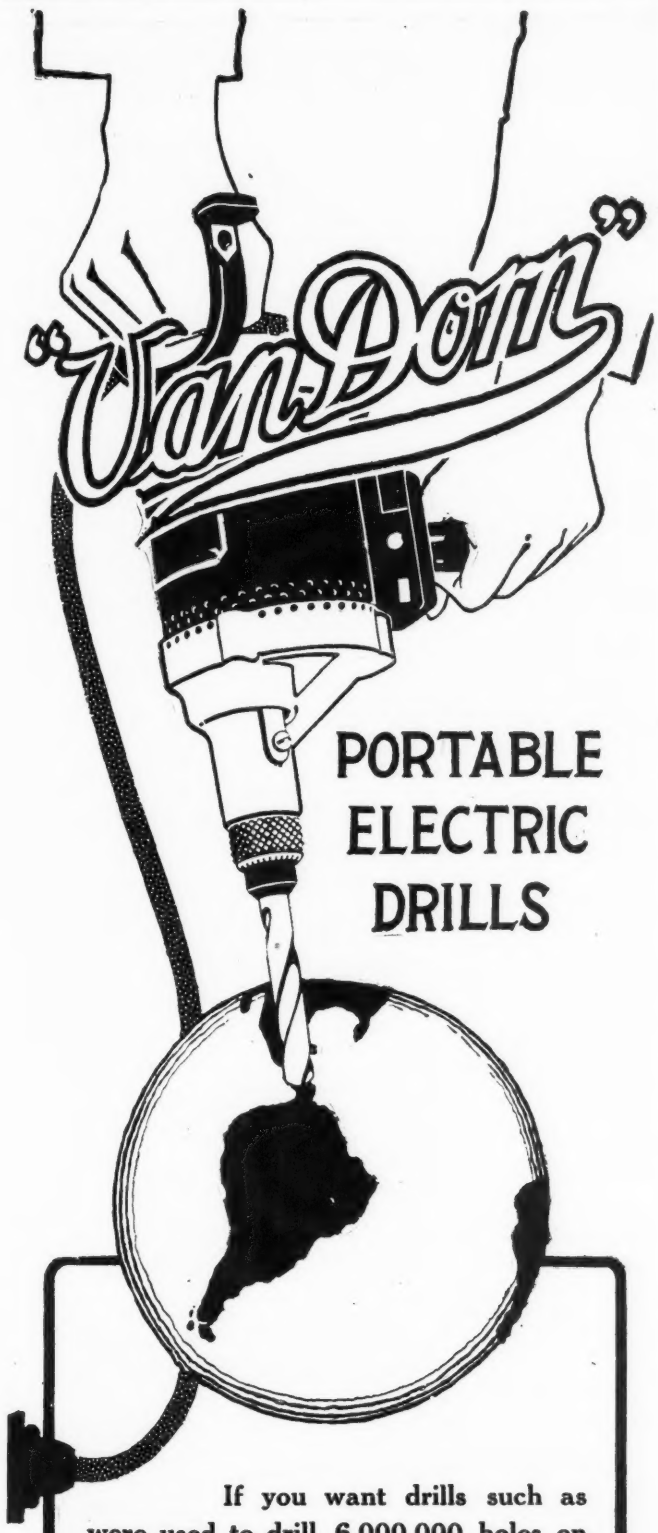
TAPPING REVOLUTIONIZED WITH THE "DOUBLE-GRIPP" TAP HOLDER

WILLIAM L. PROCUNIER · THE DOUBLE GRIPP · CHICAGO, ILL.

THE NEW WAY OF HOLDING TAPS

The advantage in using the "DOUBLE-GRIPP" is that you do not require bushings or sleeves for the different size taps, as they are all equipped with the famous "DOUBLE-GRIPP" self-centering jaws and will take any standard make of tap. Straight, taper and special shanks to fit any make of machine.

WILLIAM L. PROCUNIER
208 N. FIFTH AVENUE CHICAGO, U. S. A.



PORTABLE ELECTRIC DRILLS

If you want drills such as were used to drill 6,000,000 holes on Panama Canal Work—drills that will stand up under work that sends other makes to the repair shop—tell us what your work is and we will quote you on a tool that will stay out of the repair shop.

The Van Dorn Electric Tool Co.
Cleveland, O.

SALES OFFICES

New York, N. Y., 30 Church St.; Boston, Mass., 170 Purchase St.; Baltimore, Md., 339 Title Bldg.; Chicago, Ill., 601 Monadnock Bldg.; Pittsburgh, Pa., 701 Empire Bldg.; Cincinnati, O., Second Natl. Bank Bldg.; Atlanta, Ga., 1018 Healy Bldg.; St. Paul, Minn., American Natl. Bank Bldg.; Kansas City, Mo., 1311-13 Baltimore Ave.; Denver, Colo., Ideal Bldg.; San Francisco, Calif., 515 Mission St.; Los Angeles, Calif., 325 Security Bldg.

Tighten the Grip of the Main Belt

This cork inset pulley—in every other respect exactly like the standard, smooth-faced American Steel Split Pulley—insures absolute grip at that "one time out of a thousand" when other pulleys *might* slip.

It is made to take the load of the main drive belt and transmit *all of it*. So the cork insets are put in. They *hold* the belt. It *can't* slip. The belt would tear first.

The insets will wear almost as long as the pulley.

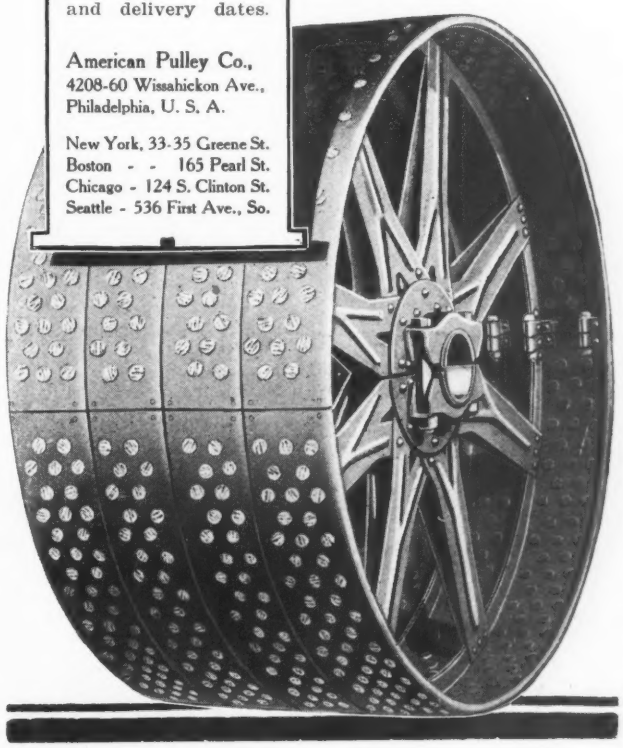
These pulleys have been on the market several years, and we don't know of any that have actually *worn out* in service.

AMERICAN STEEL SPLIT PULLEY —with CORK INSETS

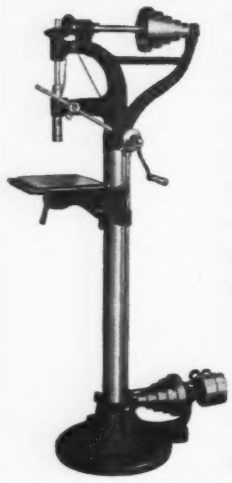
Over 60,000 pulleys—3" to 120" in diameter—stocked at centers named below, and additional thousands stocked by over 200 dealers, insure prompt deliveries. Write for quotations and delivery dates.

American Pulley Co.,
4208-60 Wissahickon Ave.,
Philadelphia, U. S. A.

New York, 33-35 Greene St.
Boston - - 165 Pearl St.
Chicago - 124 S. Clinton St.
Seattle - 536 First Ave., So.



The Lindgren
13-INCH HIGH SPEED DRILL

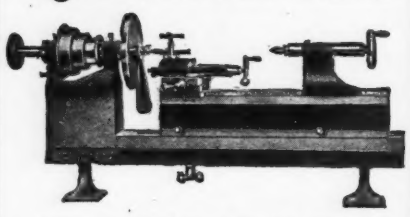


All bearings are bronze bushed and provided with ring oilers. The spindle has ball thrust bearings. The sleeve is graduated in inches.

New lubrication features
No leakage of oil.

F. W. LINDGREN CO.
ROCKFORD ILLINOIS, U. S. A.

Elgin Precision Lathes



have been built for years and supplied to an exclusive list of very particular lathe users. They are superior in design and workmanship and especially adapted for the tool-room, laboratory or experimental room where super-accurate work is a necessity. If you want a lathe made like a watch, buy an Elgin.

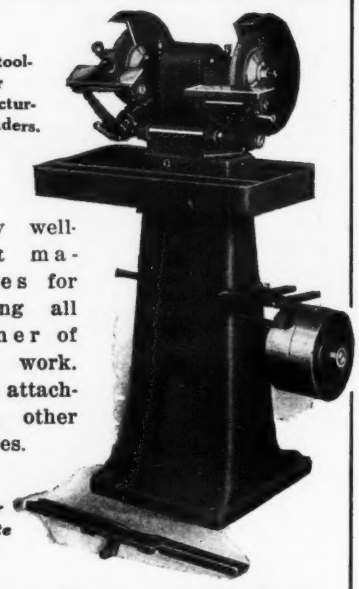
Write for details.

THE ELGIN TOOL WORKS
ELGIN, ILLINOIS

ENGINE LATHES
18' to 48' Swing
The Boye & Emmes Machine Tool Company Cincinnati, Ohio

ANDERSON GRINDERS

Handy tool-room or manufacturing grinders.



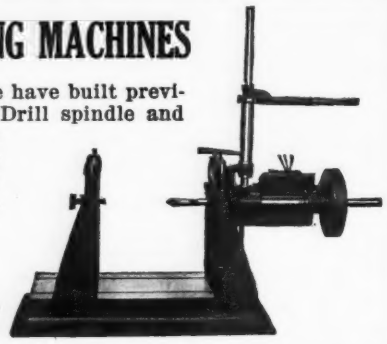
Sturdy well-built machines for grinding all manner of small work. Bevel attachment; other features.

Ask for complete details.

Worcester Pattern and Model Co.
93-95 Foster St., Worcester, Massachusetts

SOMETHING NEW IN BALANCING MACHINES

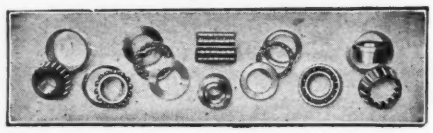
It is a more universal machine than any we have built previously. Obtains its power from a motor. Drill spindle and motor adjustable up and down. Takes fly-wheels 10" to 18" diameter and handles shafts 30" long between the tool standards. We have just sold eight of these tools to the Ford Company.



Can you use one?

Rockford Tool Company
ROCKFORD, ILLINOIS

BALL AND ROLLER BEARINGS



The New Departure Service Station
THE GWILLIAM COMPANY
New York 253 W 58th Street Philadelphia 1314 Arch Street

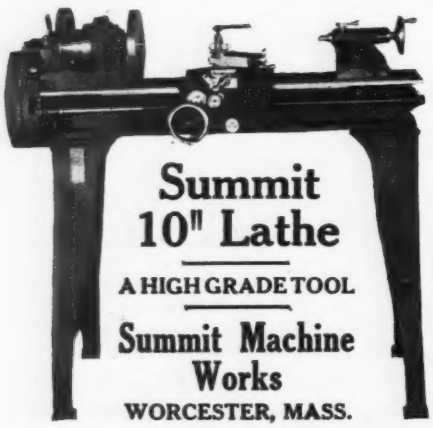
FLEXIBLE STEEL TUBING

CONTAINS NO PACKING

FOR SUPPLYING LUBRICANT TO MACHINE TOOL CUTTERS

SEND FOR DETAILS

WHEELOCK MFG. CO. WHEELOCK, VT.



Summit 10" Lathe
A HIGH GRADE TOOL

Summit Machine Works
WORCESTER, MASS.

White Metal Die Castings

PARKER WHITE METAL & MACHINE CO.
ERIE, PENNSYLVANIA

FRANCKE FLEXIBLE COUPLINGS
FOR DIRECT CONNECTED MACHINERY
Any Size Shaft, Power or Speed
SMITH-SERRELL CO., Inc.
General Sales Agent for THE FRANCKE CO.
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COMPARE

with your present Handle costs our prices for Ball Cranks and Machine Handles of every description from bar steel. Accurate, highly finished, complete in every detail and ready to attach.

The Cincinnati Ball Crank Company
Cincinnati, Ohio
Successors to this dept. of the Schacht Mfg. Co.

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More than thirty-four years' experience in drawing, spinning and stamping metals, and a plant covering more than fifteen acres of floor space enable us to do difficult work right. Send blueprints or samples for estimates.

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EXCLUSIVELY

12" to 32" Stroke

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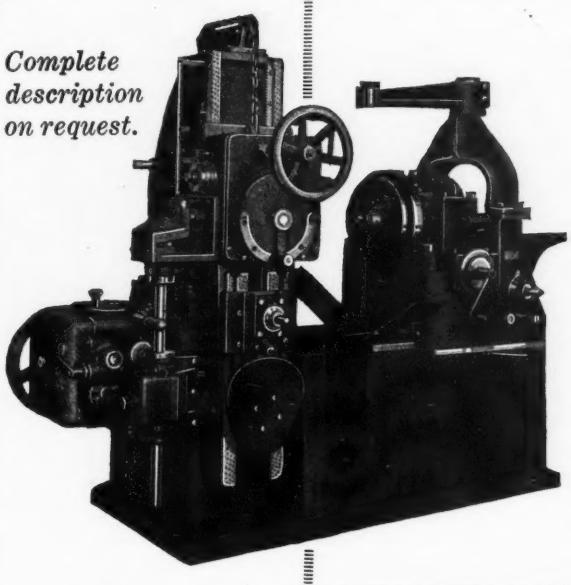
FOREIGN AGENTS: C. W. Burton, Griffiths & Co., London. G. & F. Limbourg Freres, Brussels. Van Rietschoten & Houwens, Rotterdam. Glaenzer, Perreaud & Thomine, Paris. Stussi & Zweifel, Milan.

GEARING

Four compact books covering this important subject completely. ***No. 1—Worm Gearing. No. 15—Spur Gearing. No. 20—Spiral Gearing. No. 37—Bevel Gearing.*** All units in MACHINERY'S Reference Series, 25c. each.

Complete description on request.

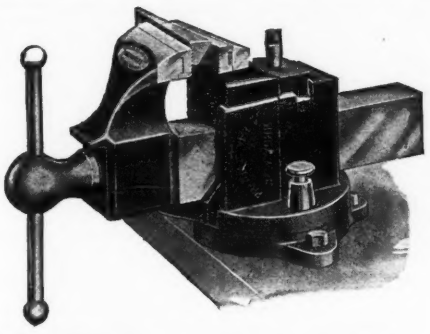


Simplified Cam Cutting

The **Rowbottom Universal Cam Milling Machine** does work that formerly required two types of machines to handle, cuts any style cam up to 28 inches diameter, and does its work at extremely low cost.

The "Rowbottom" differs in principle from all other cam cutting machines. Cutter is mounted on a head that operates vertically through a roller against the master cam—no chance for backlash—the weight of the cutting head is always in compression. Other interesting features.

THE ROWBOTTOM MACHINE CO.
WATERBURY CONNECTICUT, U. S. A.
FACTORY: Waterville, Connecticut



Machinists' Swivel Vise

with self-adjusting jaw that is as strong and durable as any solid jaw, and a Swivel Bottom that gives any desired adjustment to right or left, and is solid and firm at any angle. We make all sorts of good vises, and have been leaders in this line for forty years. Send for catalogue and price list.

PRENTISS VISE COMPANY
106-110 Lafayette St. NEW YORK
Sole Agents for Canada
A. MACFARLANE & COMPANY
Coristine Bldg., Montreal.

THE SCHWERDTLE STAMP CO.,
STENCILS-BURNING BRANDS
STEEL STAMPS & DIES
SEALS-MACH. PLATES-CHECKS
BRIDGEPORT, CONN.

PEERLESS
High Speed Steel

Also full line of Regular Crucible Steels and Steels for special needs.

Write us for particulars.

HELLER BROS. CO.
NEWARK, N. J.

High Speed Spiral Mills
Cutters
Circular Tools
Special Small Tools

An inquiry may enlighten you.

WINDAU TOOL COMPANY
Cleveland, Ohio, U. S. A.

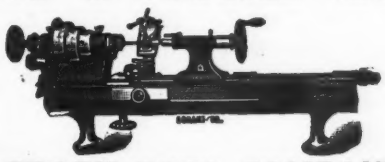
A Box of Bits at a Bargain Price - $3.40

A full set of 13 of our popular Lakeside Solid Center Stem Auger Bits. Double cutter, two spurs, standard double thread screw. Bore fast and true. Finest steel, correctly shaped, well tempered, finely polished. One each 1-4, 5-16, 3-8, 7-16, 1-2, 9-16, 5-8, 11-16, 3-4, 13-16, 7-8, 15-16, 1 inch, in handy, upright wood box, hinged cover, nicely varnished. Shipping weight 5 1-4 lbs.

One of the many bargains from our big stock of tools. May we send you our Tool Book? It's FREE. Buy tools at wholesale prices.

Montgomery Ward & Co
Dept. AH541
Chicago New York
Kansas City
Ft. Worth Portland, Ore.
Order from most convenient house

A STARK BENCH LATHE



Will soon show its worth in the shop where accurate work is essential.

STARK PRECISION TOOLS are made from finest materials, by skilled workmen and from up-to-date designs.

Ask for Catalogue B.

STARK TOOL COMPANY, Waltham, Mass., U. S. A.

W&P

—it stands for progressiveness. We have just added the Hy-Speed Accelerating Cut Planers to our standard planers and reversing motor planers. *Particulars, if you'll write.*

Woodward & Powell Planer Co.
WORCESTER, MASS., U. S. A.

U.S.

TRADE MARK

U. S. MADE FOR U. S. TRADE

Accuracy Assured in U. S. Ball Bearings

U. S. Ball Bearings are the result of the determination to produce perfect ball bearings.

Every possible precaution is taken in order to be sure that no bearings leave our factory that do not conform in every way with the high standards we have set for ourselves.

Only the highest quality chrome alloy steel is used in the manufacture of U. S. Ball Bearings. Each bar of steel must pass our test for chemical and physical properties and be approved by our laboratories before being allowed to enter our production department. Each ball in order to pass our rigid inspection must be true in size and spherical to within one ten-thousandth of an inch.

After every operation, each component part of our bearing is subjected to the most minute inspection, and again as an assembled unit each bearing must pass a ruthless final inspection.

No bearings less accurately constructed can achieve the same elimination of friction and saving in wear on bearing parts.

Let us help you solve your bearing problems. Our engineering department comprised of a staff of ball bearing experts is always at your service.

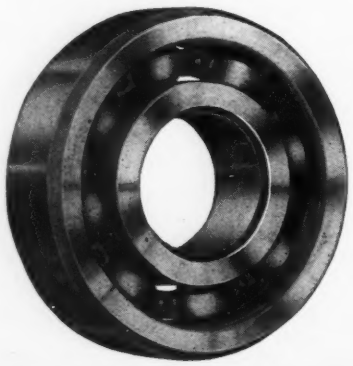
Write for Catalogue "F".

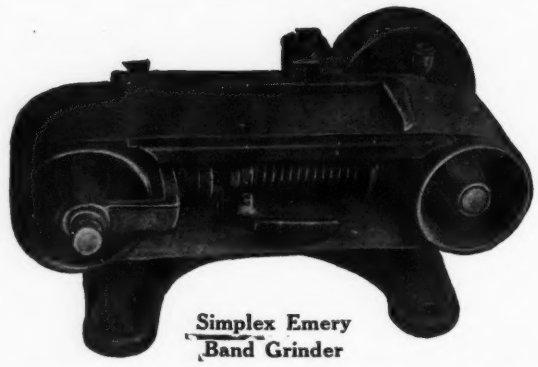
U.S. Ball Bearing Mfg. Co.

(Conrad Patent Licensee)

Palmer Street and Kolmar Ave.

CHICAGO, U. S. A.

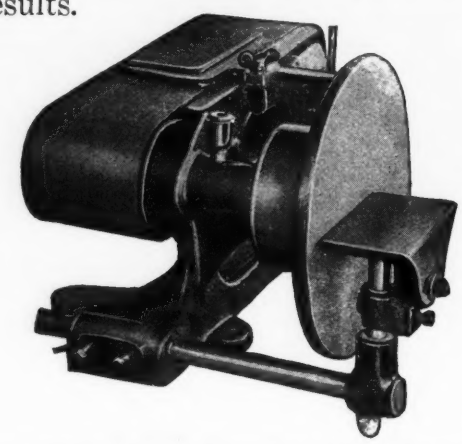




Simplex Emery Band Grinder

Straight Grain Grinding Now Done Flat

Why the emery cloth or wheel? Now lay your work lightly against an endless band of abrasive cloth. Result—clean, flat, smooth surfaces—sharp, square corners, no scratches—saving of time, reductions in cost, increased productions. Unskilled labor can produce high-grade results.



Duplex Emery Band and Disc Grinder

Compared to Simplex or Duplex Grinders, past methods appear slow and laborious. Here a band travels over a *flat* table!

No need to experiment. Leading manufacturers in all lines have the Band Grinders in their machine shops—*names of those in your own line on request.*

Ask us to show you how a machine can help you—illustrated data free.

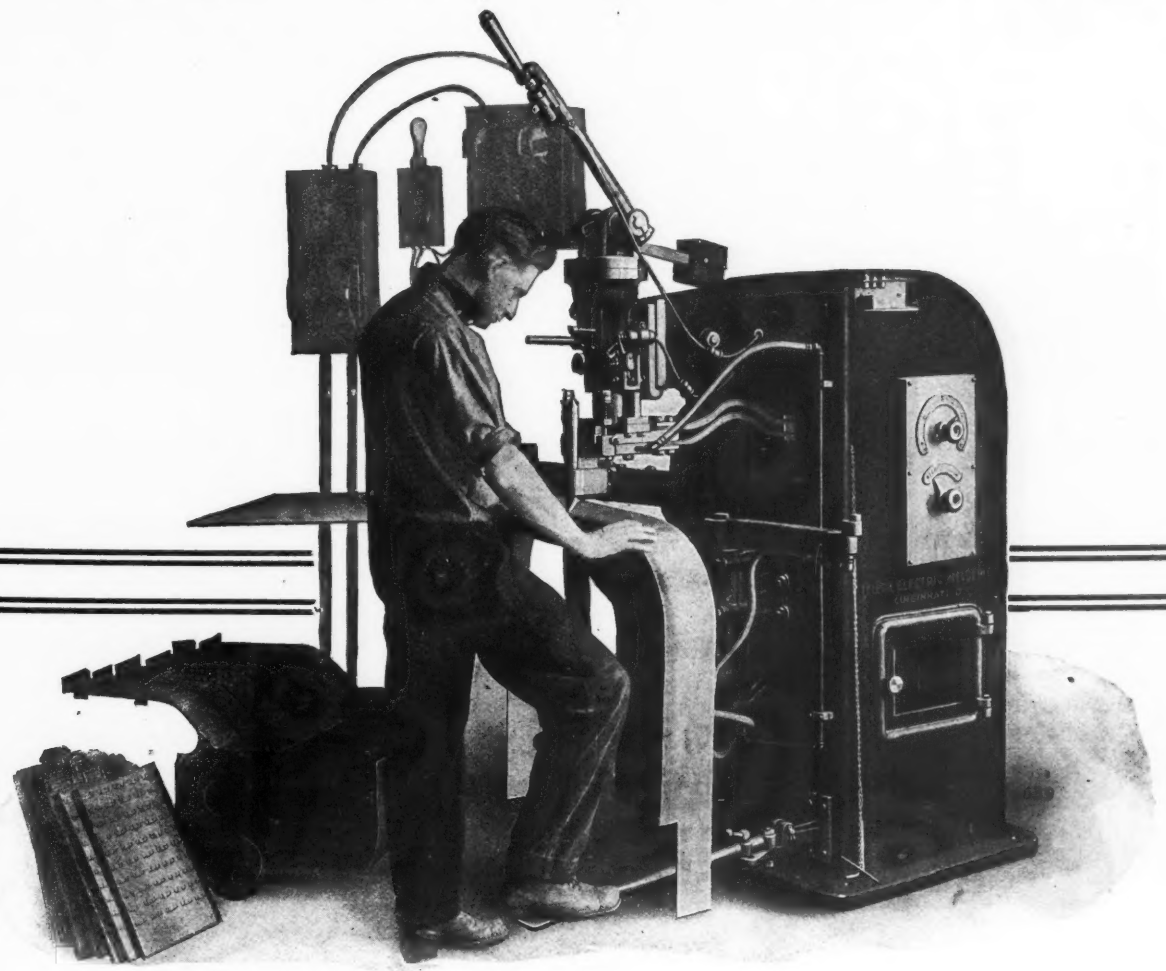
Duplex B Emery Band and Disc Grinder

T. P. WALLS TOOL CO.

75-77 Walker St.

New York, N. Y.

Riveting Costs Reduced 60% to 90%



What's the use— of riveting when you can spot weld 10 to 20 times as fast?

What's the use— of having 8 to 10 men do the work that two boys will do with a "TOLEDO" electric welding machine?

What's the use— of employing 5 or 6 blacksmiths to weld iron rods or bars—when one unskilled laborer can do more work with a "TOLEDO" butt welding machine?

What's the use— of using $3.00 to $10.00 worth of high-speed steel or "stellite" for tools when a piece costing 40 cents can be welded to 30 cents worth of carbon steel to do the same work?

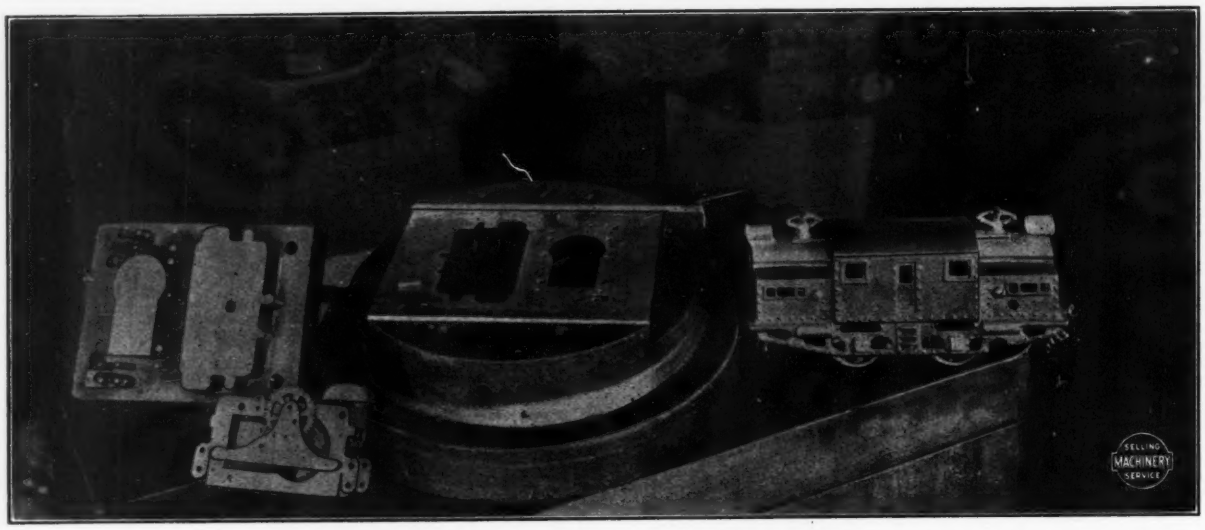
WHAT'S THE USE?

Our Bulletins Nos. 14-16-17 tell all about the saving way.

NO LEASE NO LICENSE NO ROYALTY

THE TOLEDO ELECTRIC WELDER CO.

KNOWLTON AND LANGLAND STREETS CINCINNATI, OHIO



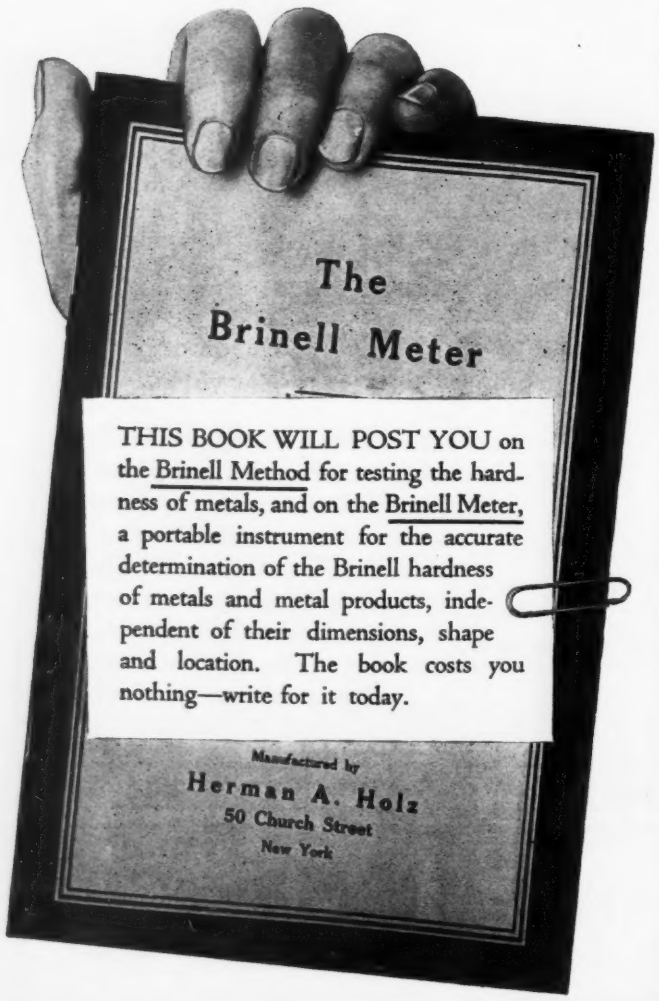
Ketos Steel Dies—Blanking Out Locomotives

Not real locomotives—toys. And the Ives Manufacturing Company (Bridgeport, Conn.) uses Ketos Steel dies to blank out the parts. Some of these dies are of complicated construction, others are comparatively simple; and Ketos has been used exclusively since 1907.

The die shown, for punching out side frames, 0.041″ hot rolled steel, for the little electric motor, has punched a million frames in the last five years—and it is good for many thousands more.

Ketos is a wonderful, oil-hardening, non-shrinking steel. We recommend it for die work. Ask for more details.

HAWKRIDGE BROTHERS COMPANY, 303 CONGRESS STREET, BOSTON, MASSACHUSETTS


The
Brinell Meter
THIS BOOK WILL POST YOU on the Brinell Method for testing the hardness of metals, and on the Brinell Meter, a portable instrument for the accurate determination of the Brinell hardness of metals and metal products, independent of their dimensions, shape and location. The book costs you nothing—write for it today.
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"HOOVER"

Stands for Quality, Efficiency, Economy and Durability in Oxy-Acetylene Welding and Cutting Apparatus.

You owe it to yourself to investigate our equipment before you buy. Write for catalogue.

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Tougher and Stronger Carbon and High Speed Drills

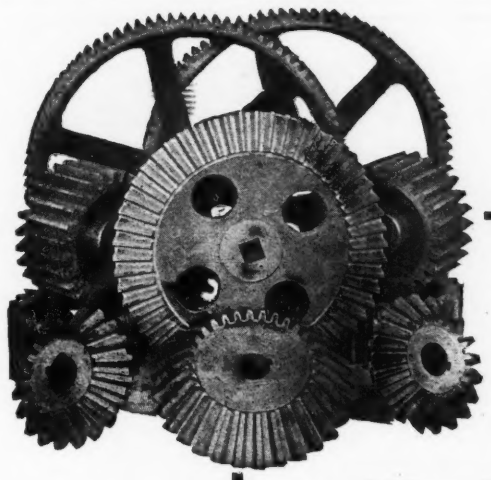
That's what our hot forging process makes certain.

Drills in which the steel is refined and the grain strength secured.

All our drills are ground to micrometer caliper gauge after tempering.

And all are absolutely guaranteed. The booklet contains their story—send for copy.

New Process Twist Drill Co.
TAUNTON, MASSACHUSETTS



Reliability Insurance

If Your First Aim in the Design of Your Machinery Is Reliability, *Insure* Reliability by Using the Best Gears Money Can Buy.

Reliability Is Nowhere More Essential Than in Electric Locomotive and Motor Car Operation, and There You Will Find Over Half a Million Nuttall Gears and Pinions, from Ordinary Cast Steel to Glass-Hard, Case-Hardened Grades. That Is Worthy of Your Consideration When Deciding What Gears to Use in Your New Machine Tools.

The Quality of Our Materials and Workmanship, Our Heat-Treating Processes and Our Guarantee Constitute Reliability Insurance of the Proven Sort.

Nuttall - - - Pittsburgh

District Sales Representatives

Atlanta—George E. Watts, Candler Building.
Boston—Charles N. Wood Co., 79 Milk St.
Cincinnati—Monroe Brass & Wire Co., Traction Bldg.
New York—Electric Service Supplies Co., 50 Church St.
Philadelphia—Electric Service Supplies Co., 17th and Cambria Sts.
Pittsburgh—Union Electric Co., Terminal Warehouses.
Butte, Chicago, Dallas, Denver, Detroit, El Paso, Kansas City.
Salt Lake City, St. Louis, San Francisco, Los Angeles, Seattle—The Westinghouse Electric & Mfg. Company.

FRANKLIN DIE-CASTINGS

Are Standard for Quality

The Franklin Manufacturing Company are the pioneers in the die-casting industry. Their process and equipment are the result of twenty-two years of development.

The Franklin factory affords ample facilities for the meeting of your die-casting requirements.

Franklin quality is the best guarantee of satisfaction.

Booklet I, describing the Franklin process and its results, should prove of value to all interested in cost reduction.

FRANKLIN MANUFACTURING COMPANY

738 GIFFORD STREET SYRACUSE, N. Y.

G & B

The Gilbert & Barker Fuel Oil System

will save you money. Hundreds of progressive concerns are showing a large annual saving over their former operating costs by using our complete fuel oil equipment.

We manufacture a variety of burners to suit all pressures—as low as 12 oz. And what is more important, all our burners are designed to completely atomize fuel oil, and thus insure a clean, clear fire and complete combustion. Further details are furnished in our Fuel Oil Pamphlet. Write for it.

G & B G & B G & B

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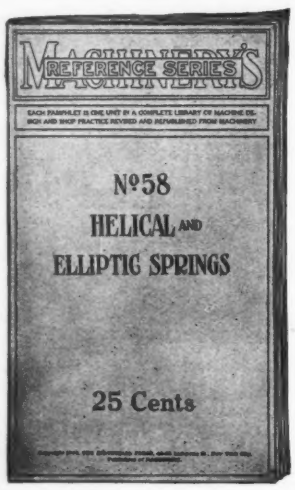
WEST SPRINGFIELD, MASS.

A BOOK ON HELICAL AND ELLIPTIC SPRINGS



Many otherwise well-informed and progressive machine designers are ignorant of calculations relating to the strength of springs, and prefer to guess at the size or kind of spring required rather than undertake its calculation. Yet the formulas upon which these calculations are based are simple in their application, and anyone, with the help of this book, can gain knowledge enough to determine accurately the sort of spring demanded.

The subject of helical and elliptic springs is covered in this book in the practical and thorough manner characteristic of all MACHINERY's famous 25 cent Reference Books. It supplies the definite information that the practical man wants and must have in his daily work. Although comprehensive, the book is concise, and has been kept down to essentials.

It is an unusual book at an unusual price. Some of the chapters are alone worth more than the cost of the entire pamphlet. Take for instance the first chapter, Principles of Spring Calculations. This begins with an explanation of the theory of spring tension, and goes on to show the various shapes of springs and the reasons for their evolution. The strength of the different classes of springs is shown with formulas explaining why one spring is stronger than another. The peculiar value of the book lies in the fact that it gives specific information and is up-to-date.

Contents of Reference Book No. 58—Helical and Elliptic Springs—Springs and Spring Calculations—Carrying Capacity of Flat Springs—Deflection of Flat Springs—The Modulus of Elasticity—Springs of Uniform Strength—Miscellaneous Classes of Springs—Torsional Springs—Helical Springs—Formulas for Capacity and Deflection of Helical Springs—The Design of Heavy Helical Springs—Springs for Railroad Cars—The Design of Elliptic Springs—Deduction of General Formulas—Springs for Automobiles—Suspension of Automobiles—Steel used in Automobile Springs—Practical Examples of the Calculation of Springs.

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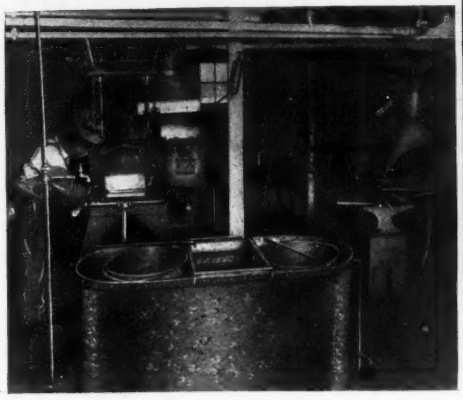
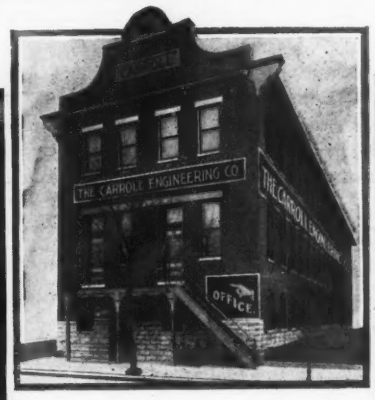
Published by MACHINERY 140-148 Lafayette St., New York

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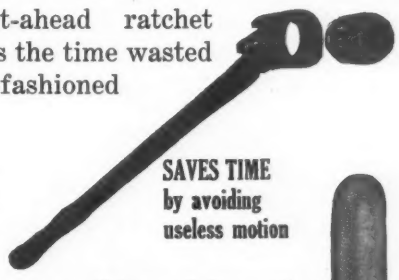

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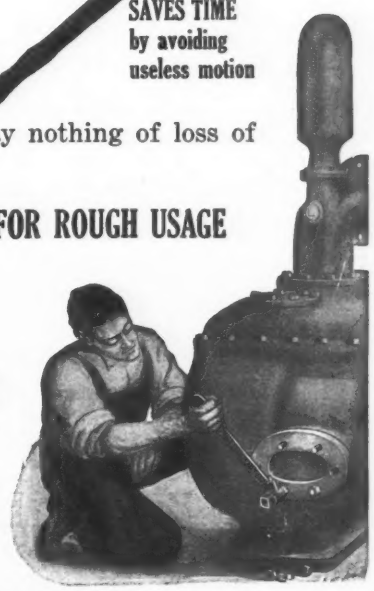

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16 x 12 American compound rest.
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20 x 10 LeBlond compound rest.
21 x 10 Bogart, plain rest.
28 x 15 Flather compound rest.
36 x 14 Pond, compound rest.
38 x 10 Harrington compound rest.
41" lathe head.

MILLERS

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No. 2 Milwaukee plain all feeds.
No. 2 Becker vertical.
No. 0 Van Norman duplex.
No. 3 Garvin duplex.
Pratt & Whitney Lincoln.

PLANERS

15 x 15 x 3 New Haven, 1 head.
24 x 24 x 8 Sellers, 1 head.
22 x 22 x 5 Wheeler, 1 head.
24 x 24 x 5 Whitcomb, 1 head.

MISCELLANEOUS

40" Hilles & Jones fish-plate shear.
26" Waiss & Root punch.
18" Perkins punch.
No. 17 Higley saw.
No. 4 Q. & C. hacksaw.
20" Juengst crank shaper.
16" Gould & Eberhardt crank shaper.
13" Gisholt turret lathe.
18 x 7 Fay & Scott turret lathe.
No. 3A Warner & Swasey turret.
3¼" Cleveland automatic.
3 x 36 Jones & Lamson turret lathe.
⅜" Cleveland automatic.
1½" Landis bolt cutter.
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1—26" Rockford Drill, T. A.
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1—Safety Wet Tool Grinder.
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2—16" x 6' Lodge & Shipley compound rest, PCF.
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1—14" x 6' Lodge & Shipley Pat. QCG chuck, complete.
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1—60" x 10' New Haven Boring and Facing Lathe, power feeds in all directions.
1—18" x 10' American, quick-change gear—with chuck.
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Springfield Universal, 16 x 40.... 850
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Two No. 3 Garvin, each..... 175
Six Pratt & Whitney, No. 1½, each 175
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Pratt & Whitney 150
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No. 2 Beaman & Smith Combination Boring, Drilling and Milling Machine, good as new.....$5000
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No. 11 Pratt & Whitney 15 spindle 325
Two 14" Barr 3 spindle Sensitive, each 90
No. 11 Pratt & Whitney 10 spindle 325
2 spindle Barr..... 60
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Allen 4 spindle..... 200
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1—40" x 40" x 12' New Haven with one or two Heads (Fine Condition)
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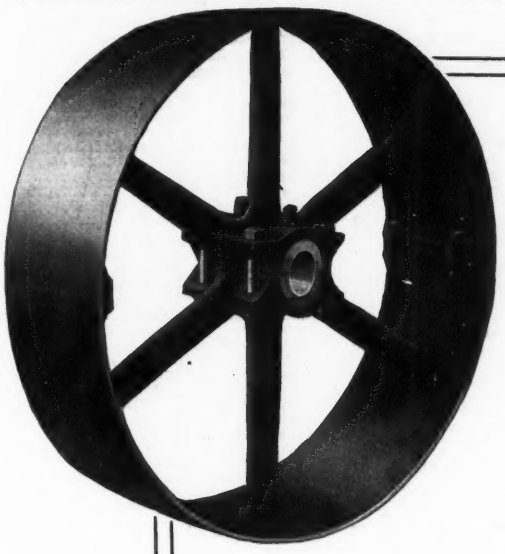

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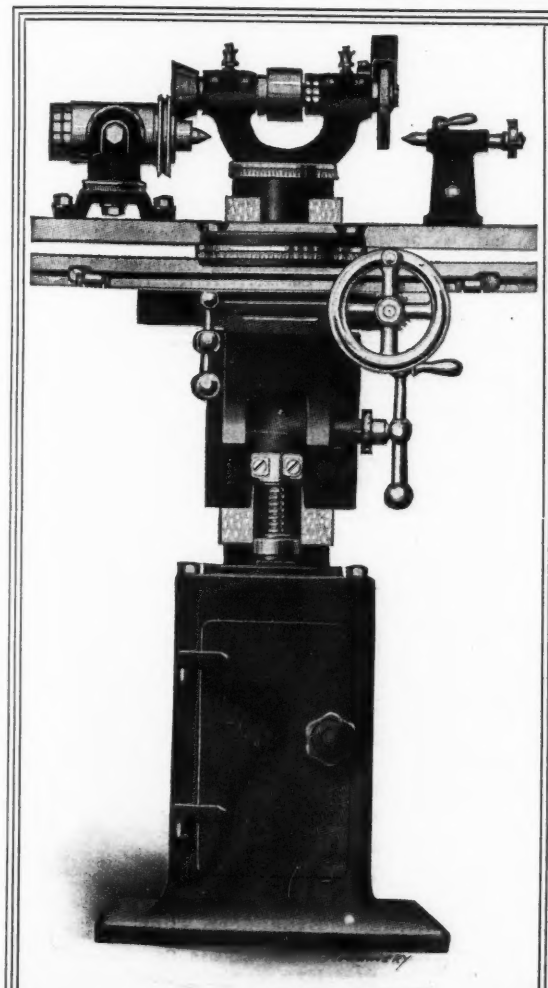

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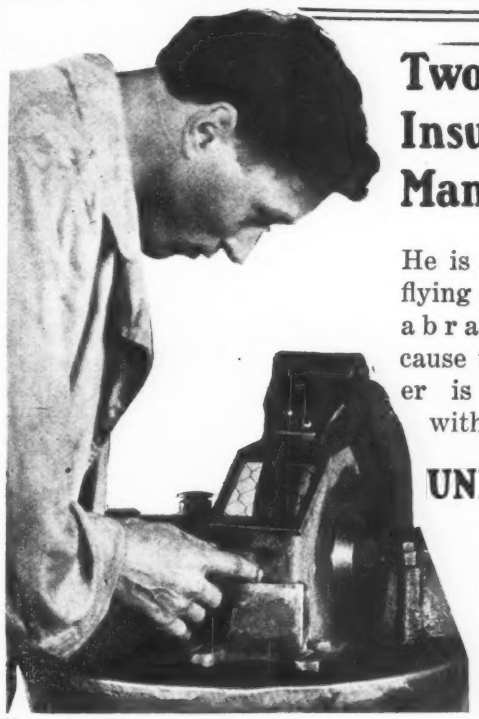

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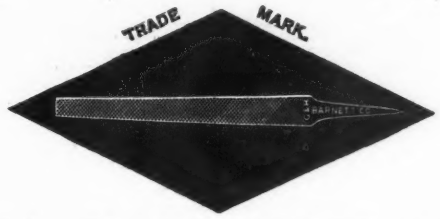

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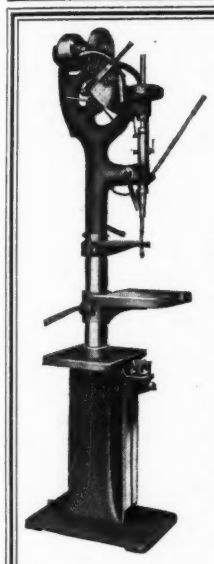

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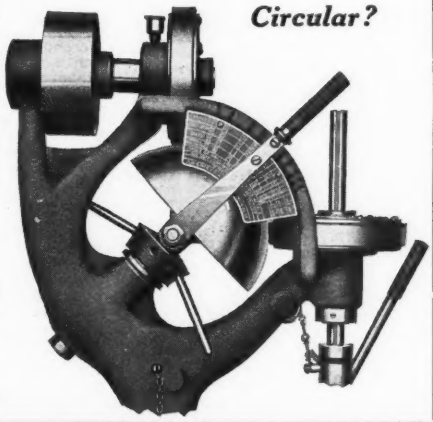

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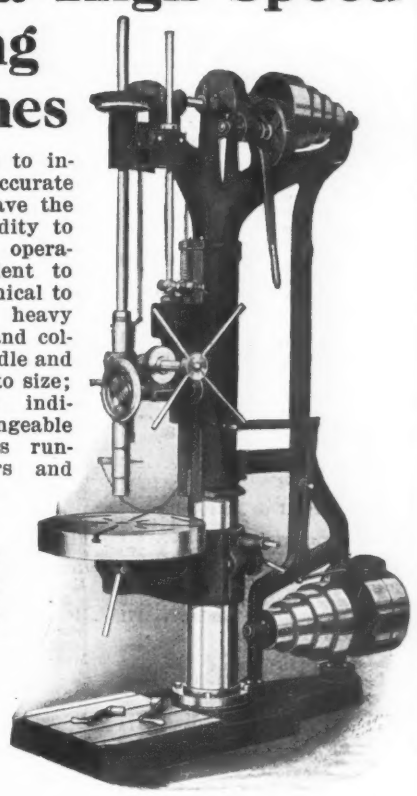

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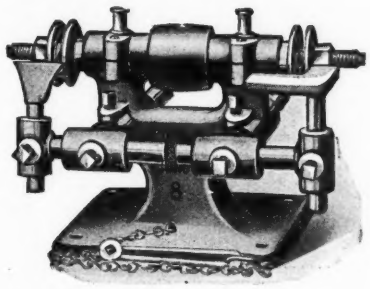

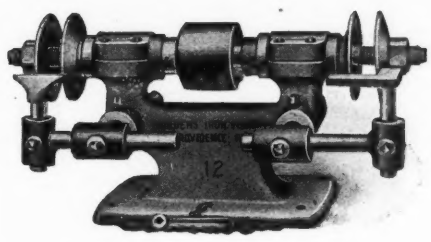

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Builders Grinding Machines

conveniently placed, will enable your men to keep tools in cost-cutting condition with minimum loss of time. They are reliable grinders, in which there is nothing to get out of order. Being made in large lots, they are moderately priced. Tested in actual service before shipment, they are safe to buy.

An equipment of these efficient grinding machines costs less than you would think.

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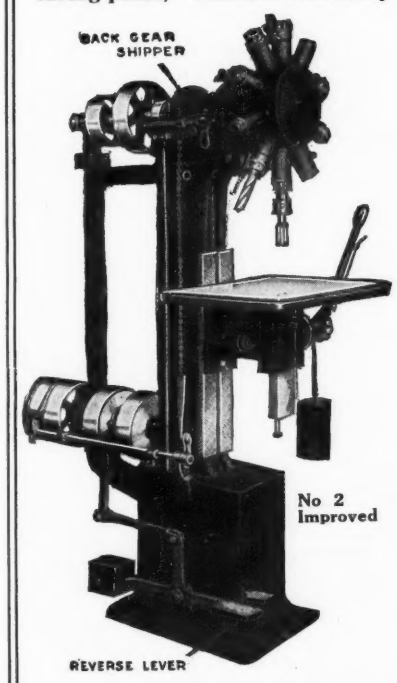
"When I was an Apprentice"

said the foreman in a large textile machinery manufacturing plant, "I used to watch my chance to work on this



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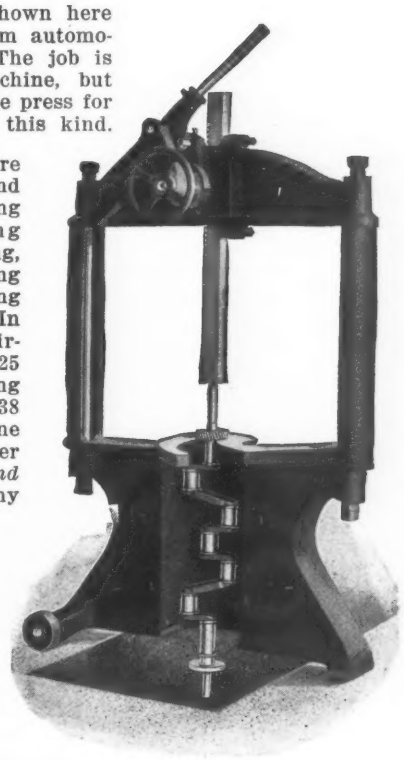
A Powerful Press Built for Extra Capacity and Permanent Hard Service

No. 26 Press is shown here removing gear from automobile crankshaft. The job is easy for this machine, but note capacity of the press for handling work of this kind.



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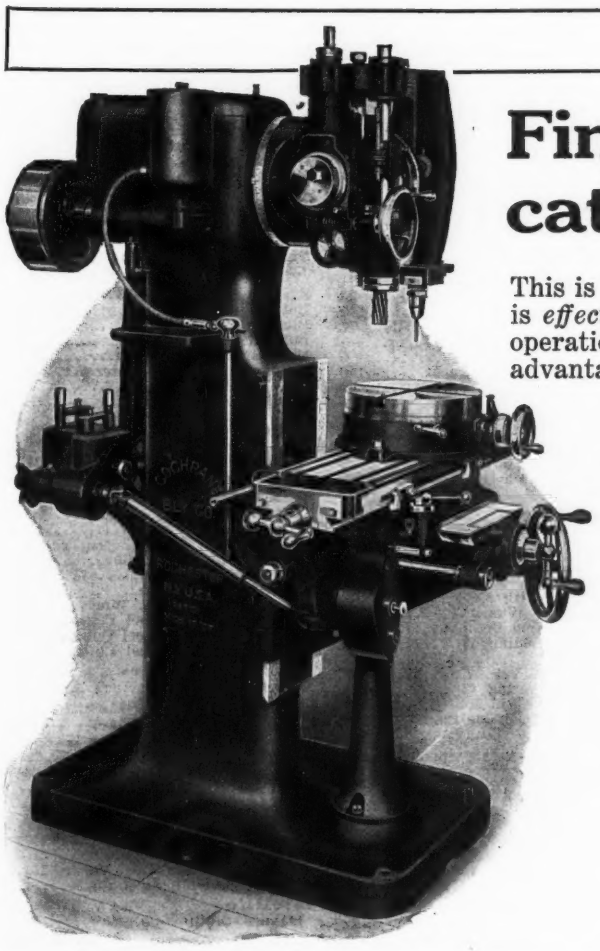

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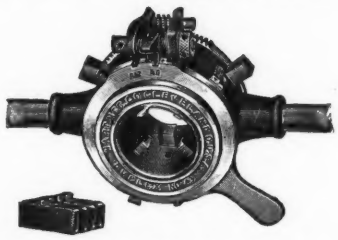

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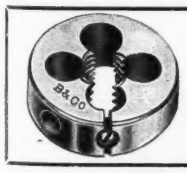

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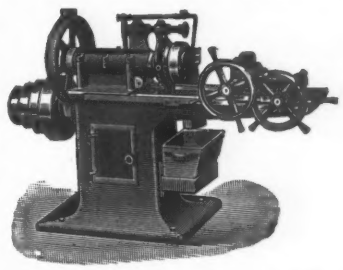

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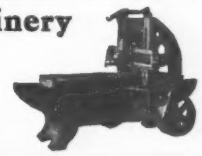

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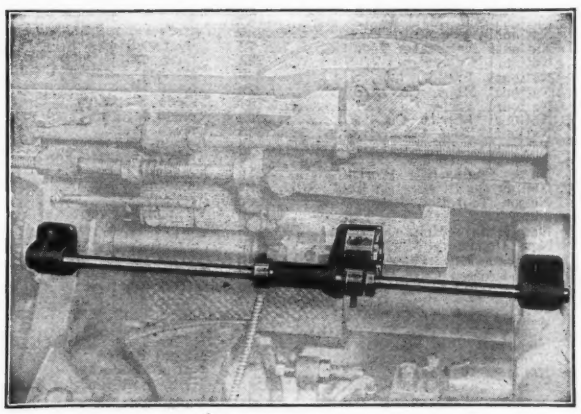

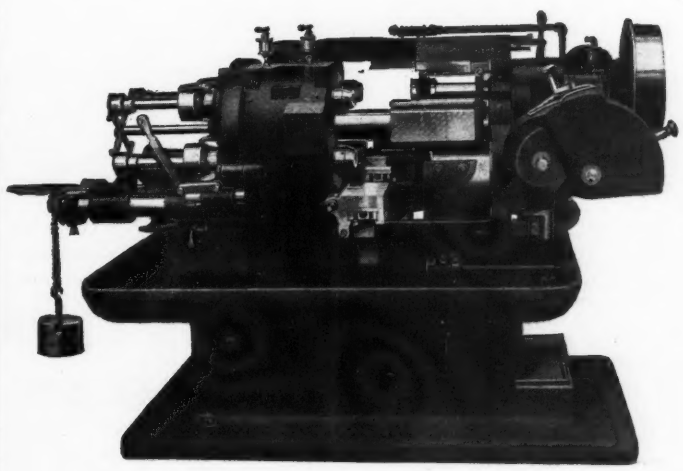

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Write for the catalog and look the line over.

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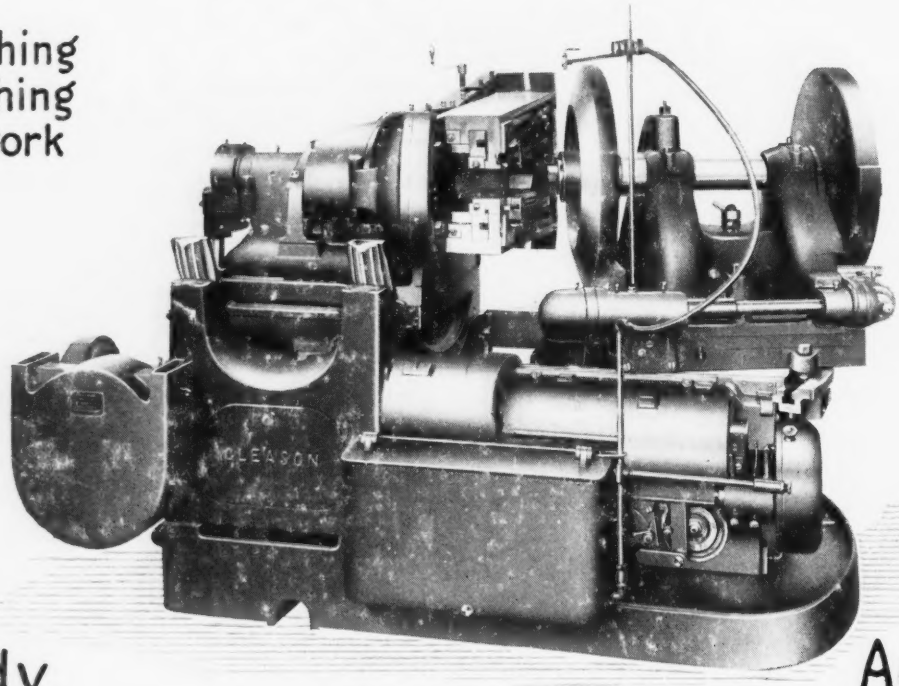

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